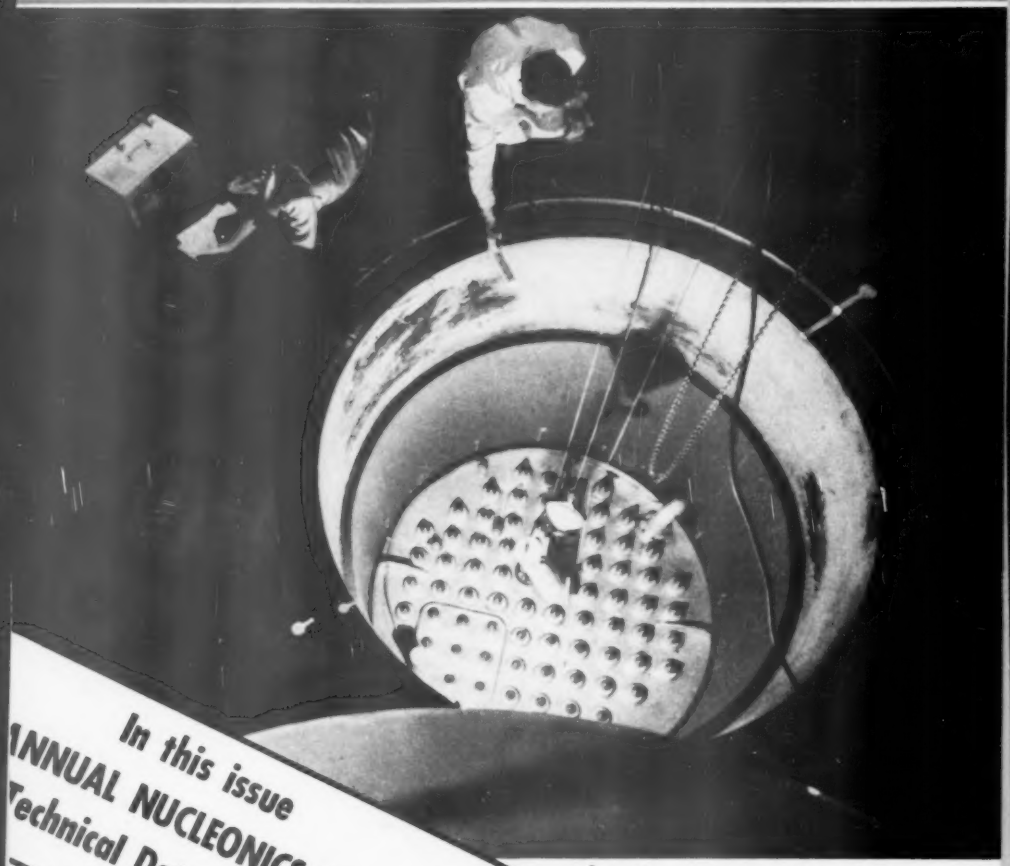
NUCLEONICS

TECHNIQUES AND APPLICATIONS OF NUCLEAR SCIENCE AND ENGINEERING

November, 1951



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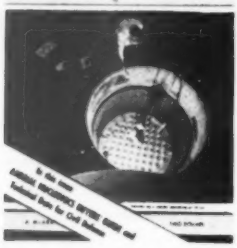

THE COVER shows the nuclear reactor at Kjeller, Norway being monitored for escaping radiation during a preliminary run at 10 kw. Instruments are hung from crane and held near edge of opening that is usually closed with shielding. The ends of the fuel rods form a pattern on the top of the reactor tank. For a description of this reactor, see p. 5.

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Norwegian Reactor

The Editors of NUCLEONICS are pleased to present as the first article in this issue a description of the design and construction of the heavy-water reactor built in Norway by the Joint Netherlands-Norwegian Atomic Energy Project. The completion of this reactor is further evidence that no one nation can have a monopoly on scientific knowledge—security cannot be achieved by locking up *the* secrets.

These two small nations are to be complimented on a job well done. They join England, Canada, France and the U. S. as countries possessing nuclear reactors. As this group increases, the need to keep scientific information secret will decrease.

(Editor's Note: Subsequent to the writing of this editorial, the Joint Congressional Committee on Atomic Energy recommended wider exchange of nonweapons data with friendly nations. *See p. 68 for details.)*

$6-Billion a Year?

The basically military nature of this country's atomic energy program was emphasized when Senator Brien McMahon, chairman of the Joint Congressional Committee on Atomic Energy, recommended in mid-September that starting with July 1, 1952, annual appropriations for atomic energy be in-

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creased from $1-billion to $6-billion. All of this increase would be used to equip our Army, Navy and Air Force with atomic weapons.

This raises two questions:

1. Why not label some of these billions for peaceful pursuits?

Perhaps development of armed might is the way to assure peace. It would seem, however, that an additional and perhaps even more dynamic demonstration of the desire for peace would be a direct contribution to the welfare of the people. If Congress does approve atomic energy expenditures of anything approximating $6-billion a year, setting aside only 1–2% of this for the building of our first nuclear power plant would certainly not be uncalled for. If for no other reason, this should be done because, in the event of peace, the only means of salvaging the vast expenditures in weapons would be to utilize the fissionable material in them as fuel for nuclear power plants.

2. How might all this money be spent?

To place the projected expansion in the proper perspective, we must look at what has been done thus far. Since the beginning of the atomic energy program in this country, the total amount appropriated to the Manhattan District and the AEC both for construction and operations comes to nearly six and a half billion dollars. What did we get for this money? Principally, we got the plutonium production reactors at Hanford, the U-235 gaseous diffusion plant at Oak Ridge, and the national laboratories at Los Alamos, Argonne and Brookhaven.

(Continued on page 87)

Random Notes

• It cost $30,000 to decontaminate two submarines which were exposed to radioactivity in the atomic weapons tests at Bikini.

• *At the Fifth Tripartite Declassification Conference in Washington in September, the British and Canadian representatives strongly recommended that serious consideration be given to declassification of cost data relative to the economics of nuclear power—such things, for example, as costs of reactors, chemical processing and fuel refining. The availability of such information in unclassified form would, they feel, assist top management in industry to assess its interest in nuclear power. This is something the Americans have never given serious thought to, but which they hope to evaluate before the next declassification conference.*

• In a recent check, AEC made the following breakdown of engineers on the project who are working as engineers: mechanical–1,770; electrical and radio–1,540; chemical and ceramics–1,030; engineers listing more than one field–440; industrial and administrative

(Continued on page 87)

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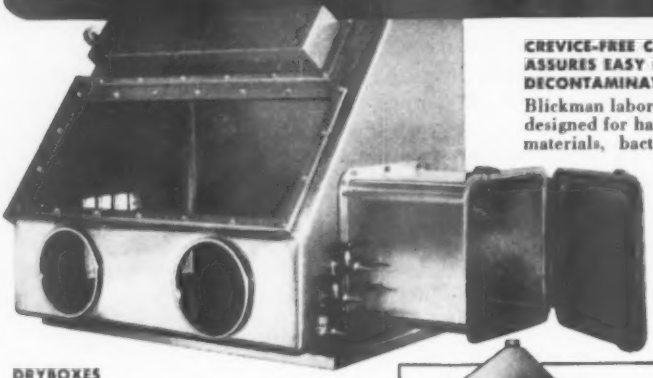

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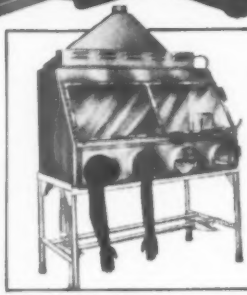

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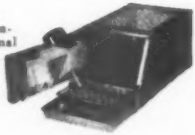

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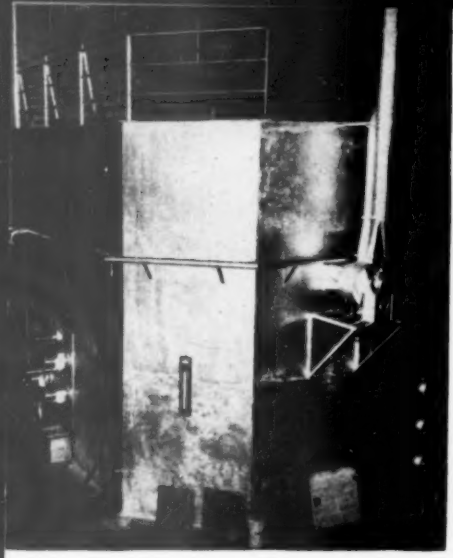

Heavy-Water Reactor at Kjeller, Norway

Here is the first published description of the 100-kw nuclear reactor just put into operation by the joint Norwegian-Netherlands atomic energy project

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Director, Joint Establishment for
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THERE WERE THREE main reasons for building the heavy-water nuclear reactor at Kjeller, near Oslo, Norway. First, a group of physicists wanted a tool for neutron research. Second, Norwegian research workers in medicine, biology, and industry wanted easy access to all kinds of isotopes, including the very short-lived ones. Third, some people thought that Norway, being one of the largest shipping nations but having to import all fuel used for shipping, ought to keep abreast of developments in the nuclear power field.

An effective impetus to construction of the reactor was Norway's production of heavy water. In addition, there was a challenge to the scientists of Norway to belie the common belief of the layman that everything connected with nuclear power is extremely difficult, so difficult as to be practically impossible for small nations. However, as specialists well know, the problems of nuclear energy are no more difficult than the average technical problems in other fields.

Also partly responsible for the decision to build this reactor was the inaccessibility of existing reactors. This certainly was responsible for the decision of the Norwegian government to give the initial grant.

At an early stage, the project became a joint undertaking of government and private industry when the firm Norsk Hydro assumed 50% of the financing. At a later time, the spring of 1951, the group of backers was extended by an agreement with The Netherlands, whereby the whole project was placed under a Norwegian-Dutch Joint Commission. The necessary amount of uranium metal was provided by the Dutch group from a prewar stock.

The reactor was put into operation at a low power level during the first days of August this year. The power

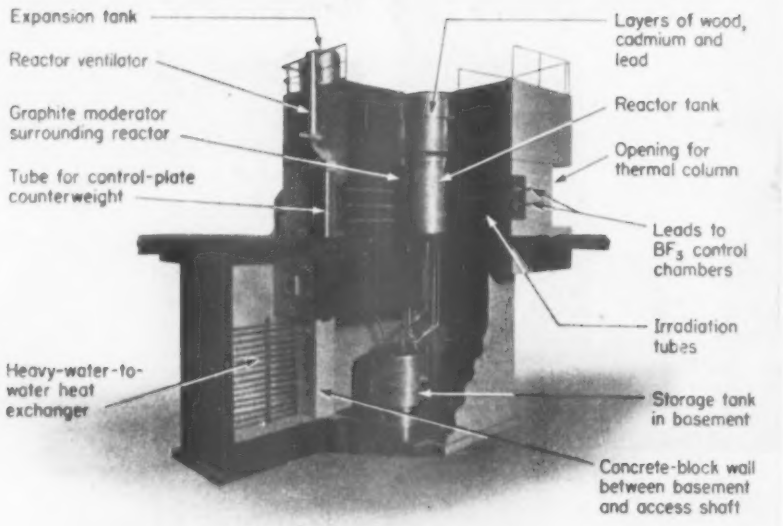

FIG. 1. Labeled model of reactor shows relation of components

level is gradually being increased while tests and measurements of the performance of the reactor are made. Test runs have been made up to 100 kw.

The reactor is designed to operate continuously at an energy level of 100 kw or more, providing a central neutron flux greater than 3×10^{11} n/cm²/sec. The basic design is similar to comparable Canadian, American and French reactors. Heavy water is contained in a thin-walled tank that is surrounded by a graphite reflector. Aluminum tubes containing the uranium charge are suspended vertically inside the tank. The heat developed in the uranium during fission is removed by circulating the heavy water through a heat-exchanging system outside the concrete shield that encloses the reacting unit.

Cadmium plates sliding between the reflector and the reactor tank are used to control the reactor. The heavy-water moderator can be dumped into a storage tank under the reactor to halt the chain reaction in emergencies.

Detailed information about the components of the reactor and their operation is given in the following pages. The relationship between these components can be seen in Fig. 1.

Reactor Tank

The tank, 2 meters in diameter, holds 7 tons of heavy water. It is made from plates of 99.5%-pure aluminum, butt-welded in an argon arc and hammered to reduce residual stress. The body of the tank is welded to a reinforced top plate that supports the uranium rods.

The bottom of the tank is unsupported from below. The entire weight of the tank and its contents—about 11,000 kg—is supported by the rim of the top plate; this rests on a lip of the concrete shield (Fig. 4). Design calculations indicated that either a flat or hemispherical-bottomed tank would

FIG. 2. Inside of reactor tank as seen through manhole in top plate. Irradiation tubes cross at right angles. Inlet for heavy water is in center of bottom, and four outlet tubes lead from overflow outlet that rings the inside of tank

rupture. Therefore, the tank was built with a rounded joint between the bottom and the side wall. Test measurements indicated a permanent longitudinal stretch of the tank of less than one part in one thousand after the first filling of water, with the diameter and radius of curvature remaining almost unchanged.

Top plate. The top plate is a very short cylindrical drum, its top and bottom joined by short sections of aluminum tubing that serve as guide sleeves and support seats for the fuel rods. There are 76 sleeves through the top; these are distributed in a rectangle on 180-mm centers. A manhole is provided, but its cover is built to seat rods so that the pattern is not broken.

Neutron-absorbing material should not be introduced into the volume of a reactor, but it cannot be avoided completely. For instance, mounted in the manhole cover is a unit consisting of an aluminum float supported in glass guides. The float is connected to a section of steel tubing that moves inside a system of solenoids as the water level changes; signals from this system govern an automatic water-level control. To measure water temperature in the tank and to get information about temperature distribution, three resistance thermometers encased in aluminum tubing also project down into the tank from the top plate.

Irradiation tubes. Material to be irradiated can be introduced into the central, heavy-neutron-flux region of the reactor through six horizontal alu-

FIG. 3. Reactor chamber in shield. Cadmium control plate slides next to reactor tank at the left. Irradiation tubes extend across space that later will be filled with graphite reflector. Holes in wall are for BF_3 chambers. Sheets of cadmium line walls of compartment

minum tubes that pass through the reactor tank (Fig. 2). Two sets of three tubes each cross at the axis of the tank; alternate tubes are 250 mm apart, center to center. The tubes have an inside diameter of 63 mm and a wall thickness of 3.5 mm. They are welded into the tank, and the tank wall is flattened to form a strain-relieving diaphragm.

Sections of the tubing outside the reactor tank (Fig. 3) lead clear through holes in the concrete shield, but are fastened to the shield at its outer wall only. The tubes thus have axial freedom, keeping the joint at the tank free of strain. The outer ends of the tubes are closed by cadmium-tipped brass plugs.

Material to be irradiated in the reactor is put in aluminum capsules inserted into a short length of graphite of about the same diameter as the irradiation tube. These units may be pushed to the center of the reactor with a ramrod, and pushed through for removal at the opposite shield face after irradiation.

Water connections. The inlet for the heavy water is in the center of the bottom of the tank. A baffle deflects the water radially to insure good mixing.

The outlet consists of a perforated circular aluminum tube fastened to the inside tank wall just below the operating water level; this can be seen in Fig. 2. This tube is connected to four outlet tubes, one running down the tank wall in each quadrant. These outlet tubes are joined together to form a single pipe below the reactor tank.

Normally the inlet and outlet pipes are connected to the cooling units through a pumping system. But in emergencies, the heavy water can be dumped through the inlet pipe into the storage tank below to stop the chain reaction. Details of this and other piping are given in the section "Cooling System" on page 12.

Uranium Charge

At the present time, 2,200 kg of metallic uranium are in the reactor tank. This uranium is in the form of slugs 25.4 mm in diameter and 300 mm long. The slugs are stacked into aluminum tubes with 2-mm walls; two of these tubes connected on 40-mm centers by a rigid bridge structure form a fuel rod. The effective length of a rod—that is, the height of the uranium column—is 1.9 meters. When inserted into the tank, the top of the uranium column is about 100 mm below the water level.

The space in the tube above the uranium slugs is filled with graphite. The bottom of the tube is sealed by an aluminum disk welded in place. A short section of graphite between this disk and the bottom uranium slug provides heat insulation during welding.

On the top of each rod is a terminating head and an adapter for the remotely controlled grip of the hoisting

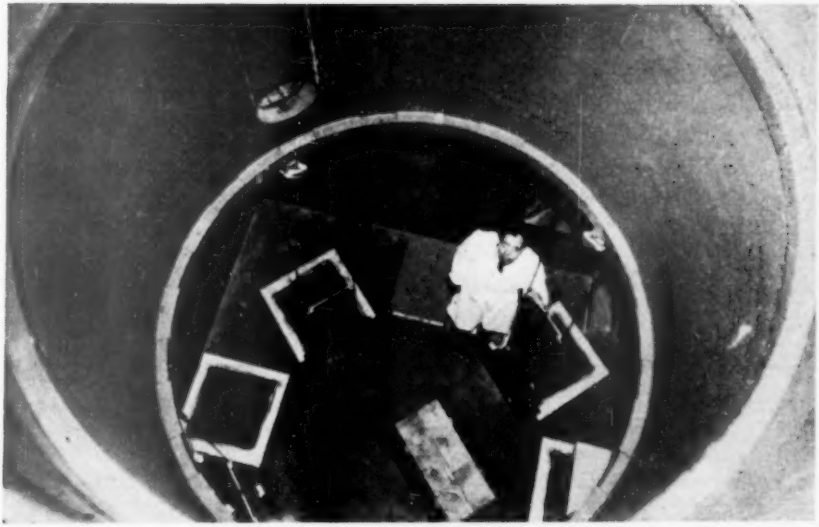

FIG. 4. View through opening in top of shield before reactor tank was lowered into place. Ledge on which top plate of reactor rests is clearly visible, as are cadmium control plates. Squares outlined on floor of reactor compartment indicate position of columns of graphite which make up main part of reflector

device. A complete rod containing 35.5 kg of uranium weighs 43 kg.

The head of each fuel rod in the reactor seats on top of its sleeve in the top plate. A neoprene ring gasket seals the joint. A little farther down on the rod, another ring gasket fits snugly in the sleeve and keeps the rod from swinging.

Reflector

Graphite blocks make up the reflector. Blocks 700 mm long and 140 mm square are stacked in eight columns, each 700 mm square (Fig. 4). These columns surround the reactor tank and reach from floor to ceiling in the reactor chamber. The corners of the columns almost meet, and the eight 45-degree sectors between adjacent columns are filled with graphite blocks cut at one end to fit (Fig. 6). The reflector thus has a minimum thickness of 700 mm and extends 270 mm above the top of the uranium in the fuel rods.

The space under the reactor tank is also filled with a 400-mm stack of graphite blocks. A total of 32,800 kg of graphite with a specific weight of 1.68 is used in the reflector.

As the friction between machined graphite surfaces is very slight, a small amount of binder is applied to horizontal faces of the blocks to prevent slipping during stacking.

Biological Shield

The reactor tank and reflector are enclosed by reinforced concrete in which granite was used as filler. This shield, 7.5 meters square with a prism cut from each vertical corner, is in no place less than 2 meters thick. The top of the shield is about 5 meters above the floor level of the reactor room. An external view of the shield is shown on page 5.

A large cylindrical hole in the center of the flat top of the shield leads down to the 3.5-meter-square by 2.9-meter-high reactor compartment. The walls of the reactor compartment are lined with cadmium for added shielding.

The reactor tank is lowered into place

Cost of Reactor

Here is the cost breakdown for the Kjeller reactor and related facilities. Since it is very difficult to determine the exact cost of the uranium, no figure is given for it.

Reactor building and shield	$72,000
Reactor tank and cooling system	$50,000
Electronic and automatic equipment	$57,000
Heavy water	$2,000,000
Total, without uranium	$2,179,000

In addition, a $143,000 radioactivity laboratory and a $85,700 physics laboratory were built so that the reactor functions of isotope production and nuclear research could be achieved.

through the opening in the top of the shield and rests, supported by the projecting rim of the tank top, on a circular, asbestos-padded ledge (Fig. 4). Originally, the space above the reactor tank was closed with two water-filled tanks. A 4-meter column of water thus provided radiation shielding. However, the tanks had to be removed to change fuel rods.

The water tanks are being replaced with layers of wood, cadmium and lead. Holes perforating the layers will align with the fuel rods so that they can be removed. These holes will be closed with steel-and-concrete plugs.

In addition to the large reactor-tank opening, four 600 × 600-mm vertical shafts lead from the top of the shield to the corners of the reactor compartment. These allow access for stacking the graphite blocks of the reflector, and are then plugged with tanks containing sand and gravel.

Experimental and control openings. Besides the holes used in construction, there are several other openings in the shield. A thermal column containing 11,800 kg of graphite pierces the shield through one of the cut-off corners (Figs. 5, 6). This 1.8 × 1.8-mm column has an effective length of about 2 meters. Its outer face is shielded by a lead wall 100 mm thick, with cadmium between the graphite and lead.

In the corner opposite the thermal column, two 200 × 200-mm openings are provided for fast-neutron experiments. About halfway through the shield, these holes increase to a larger cross section.

Two opposing sides of the shield are pierced by three holes for BF_3 neutron chambers used in controlling the reactor. These six openings are lined with 200-mm-diameter steel tubing. Part of the chamber mounting is made of cadmium-backed lead; this closes the openings and gives radiation protection equivalent to somewhat less than 2 meters of concrete.

Holes pierce the shield for cables connecting the cadmium control plates between the reactor tank and reflector with counterweights hung in tubes on the outside of the shield.

Twelve other openings, three through each side of the shield, are provided for the irradiation tubes that pass through the reactor tank. These holes are lined with 120-mm-diameter steel tubing. The annular space between the steel tubing and the irradiation tube is closed with a section of cadmium-backed lead sleeve.

Ventilation. All openings through the shield are well sealed. A suction blower with a stack exhausting to the roof sucks outside air through the reactor compartment, removing radio-

FIG. 5. Shaft for thermal column leads through shield to reactor compartment

active dust and gases and maintaining a low pressure in the compartment. The dust and gas thus do not escape into the building if a leak occurs.

This ventilation system also removes the equivalent of about 6 kw in heat from the reactor; this reduces the load on the heat exchangers.

The Building

The shield is partly sunk into the floor of a 20 × 16-meter room. Under the shield is a 5 × 4.5-meter basement room that is 3.8 meters high. This basement contains the heavy-water storage tank and auxiliary equipment.

Access to the basement is through a shaft that adjoins one side of the basement; this shaft is closed at the top by a removable wooden floor. Besides being used for installation of the heavy-water storage tank, the shaft provides space for heat-exchanging and pumping equipment.

The opening between shaft and basement is closed with a wall of concrete blocks. The 800-mm thickness provides adequate radiation shielding. Access to the basement for servicing is provided by a small shielded door in the wall.

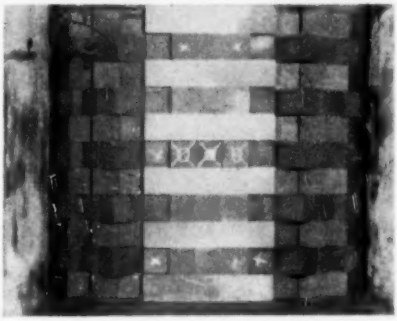

FIG. 6. Stacked graphite blocks serve as part of reflector and thermal column. Note blocks cut to fit at 45-degree angle. More graphite blocks were stacked in front of these to extend thermal column to its full length

Hoist. Traveling above the shield and the length of the reactor room is a

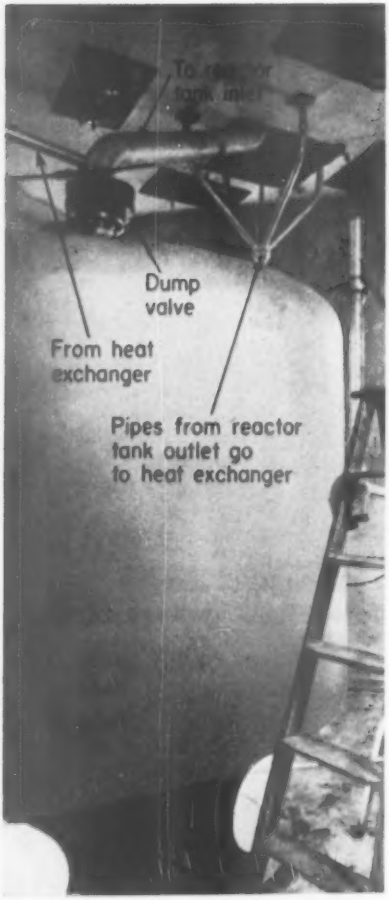

FIG. 7. Storage tank in basement under reactor tank. Dump valve, inlet and outlet connections are labeled. Note anchors for control-plate guides in ceiling of basement

1.5-ton hoist. Supported 9 meters above the floor, this hoist is used to handle tanks and fuel rods.

Auxiliary rooms. A group of smaller rooms adjoins the reactor room at each end of the building. At one end are the entrance lobby where personnel and visitors are checked in and out, and office and lavatory space. At the other end are the control room, the switchboard room, and a room for more heat-exchanging equipment. A large plate-glass window gives a good view of the reactor from the control room.

Cooling System

The cooling system, besides ridding the reactor of heat generated during fission, also is used for storage and handling of the heavy-water moderator. This is accomplished with a storage tank, pumps, valves, controls, and an internal venting and drying system.

Storage tank. The bottom of the reactor tank is connected by a 140-mm diameter inlet pipe to the top of the aluminum storage tank in the basement (Fig. 7). This pipe can be closed off by a specially designed remote-control goggle valve. When the reactor is filled with heavy water and in operation, this valve is relied upon as the last safety device; it will open automatically and dump the water into the storage tank within 45 seconds if the neutron density exceeds a preset value.

The pipe leading to the heat exchangers and pumping system is joined to the inlet pipe above the dumping valve. The outlet pipes are joined below the reactor tank and are then connected to the other side of the system.

Water level in the storage tank is indicated in the control room by a bridge-type circuit scaled in terms of water level. A float in the tank actuates an armature in a system of solenoids that form part of the bridge circuit.

Venting and drying system. The tank system is closed from the outside atmosphere to prevent dilution of the heavy water with atmospheric moisture. To prevent loss of water and formation of explosive gases, dissociated heavy water in the tank system will be recovered.

A 100-mm aluminum tube connects the tops of the reactor and storage tanks so that air can be transferred as the

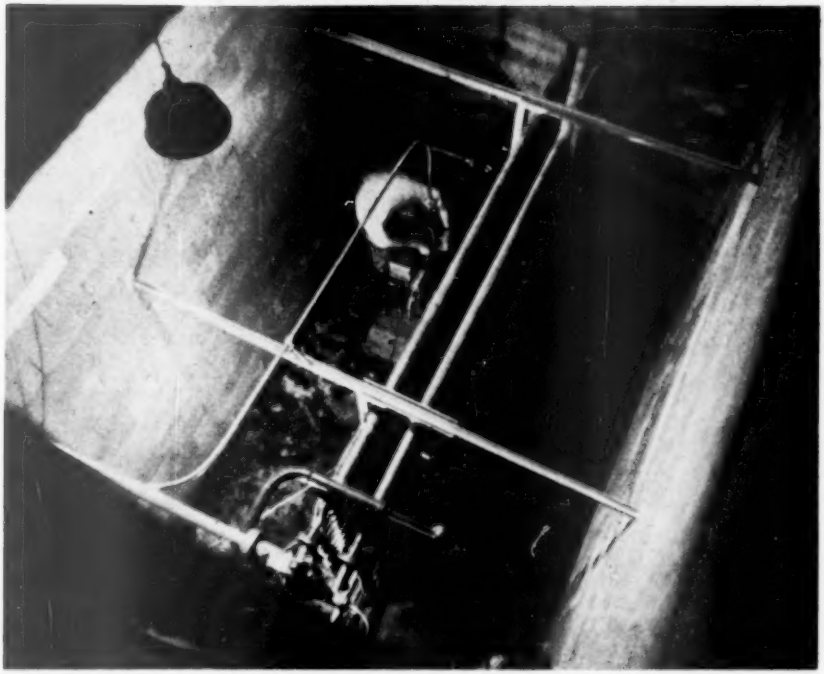

FIG. 8. First stage of heat exchanger is located in shaft next to reactor shield. Concrete-block wall at left leads to basement under reactor

heavy water is pumped in or out of the reactor tank. Aluminum goggle valves in this tube connect the tank system to a blower and silica-gel filter so that the system can be dried out before it is filled with heavy water.

As the thin-walled reactor tank cannot withstand too much pressure, an expansion tank is connected to the venting system. This tank is an aluminum drum 1.5 meters in diameter installed on top of the reactor shield. A slack rubber diaphragm forms the head of the drum, and a manometer indicates the pressure in the system.

Heat exchangers. Heat developed in the reactor is carried away by a two-stage heat exchanger. The first stage is located in the shaft next to the reactor shield; there, heat is exchanged between the heavy water and ordinary tap water (Fig. 8). The second stage, located in one corner of the building, consists of a radiator in which the tap water gives up its heat to air that is exhausted through a stack.

Water flows between the first stage and the reactor through 50-mm aluminum tubes. All flanged aluminum-to-aluminum connections are sealed with neoprene ring gaskets. The circulating pump is a stainless-steel centrifugal pump with the shaft sealed with a carbon ring-seal. The water is metered by means of a specially designed aluminum turbine meter that indicates rate and total flow in the control room by means of an electronic instrument.

First stage. For this exchanger, stainless steel was substituted for aluminum for safety. The connections

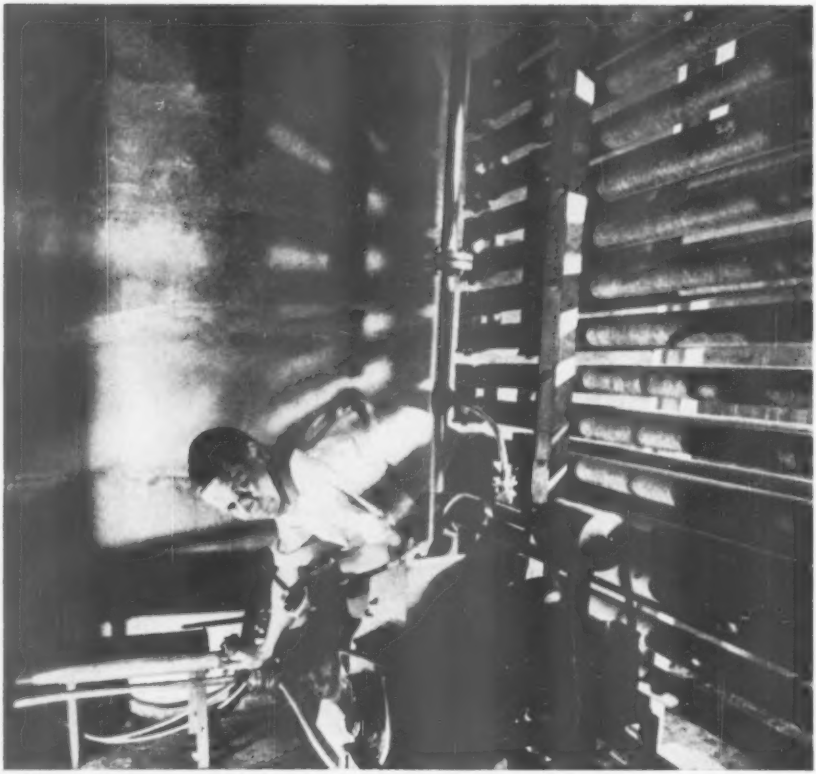

FIG. 9. Closeup of first heat exchanger shows hairpin construction whereby concentric tubes bend back on themselves. A circulating pump and several valves are also visible

between stainless steel and aluminum are electrically insulated by neoprene-rubber gaskets to reduce the danger of corrosion.

The exchanger is of a very simple concentric-tube hairpin design (Fig. 9) where all welds can be inspected. The exchange area is 10 m^2, and the water is circulated at a maximum rate of 4 liters/second. At this rate the average temperature of the heavy water will not be above 40° C when the reactor is running at the 100-kw level and the cooling water is 20° C. Inlet and outlet water temperatures are recorded in the control room.

The heavy water flows through the inner tubes of the exchanger. Ordinary water is circulated through the outer tubes and through an air radiator in a closed circuit. This water is also metered.

As the water-to-air radiator is made from copper, the connecting tubes are also copper. These tubes of 55-mm diameter are electrically insulated from the heat exchanger at points of junction. The circulating pump is a bronze centrifugal pump, also sealed with a carbon ring. The meter is also made of bronze, but is otherwise exactly like the meter in the aluminum system.

Second stage. The over-all radiator dimensions are 0.9 meter in the direction of the air stream and 2 meters square (Fig. 10). Outside air is forced through the radiator by means of a 20-hp blower and is exhausted through a low stack. Air temperatures are recorded. Operational figures for the heat-exchanging system are not yet available.

The temperature of the air through the radiator should be constant so as not to have variations reflecting back to the reactor. Constancy within a limited range of change in outdoor temperature is achieved through thermostat control of a set of louvers in front of the air intake. The complete heat-exchanging system is designed to remove at least 100 kw, maintaining 40° C average water temperature in the first stage if the intake air temperature is 20° C. To maintain this condition in wintertime, a louver-controlled bypass may be adjusted to recirculate the air and thus bring the thermostat into range.

It is possible to remove more heat from the reactor in wintertime than in summertime. Experiments will show what power level can be attained during winter operation.

Heavy-water circulation. The heavy water has to be manipulated in different ways. It is transported in 50-liter aluminum drums, and these must be emptied into the storage tank without exposing the water to air outside the tank system. It must be possible to pump the water from the storage tank up into the reactor, and the water level must be maintained within narrow limits. If the reactor tank has to be emptied and opened, the water supply must be cut off from contact with the free atmosphere, and it must be possible to pump the entire water supply over into the transport drums for reprocessing. This includes emptying the heat exchanger and the piping system.

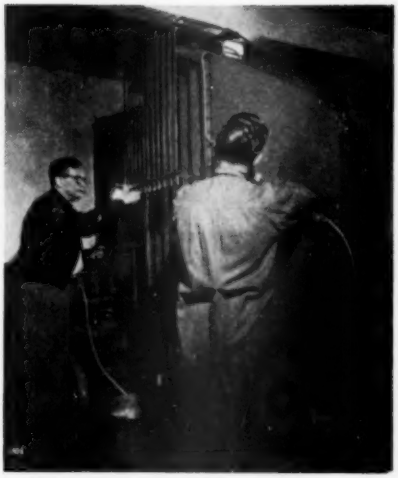

FIG. 10. Water-to-air heat exchanger. Circulating pump is between the two men

All the necessary valves for thus directing the water flow are placed in the stainless-steel section of the system. The valves are stainless-steel, force-lubricated, cylindrical tap valves.

The heavy-water circulation pump is also used for pumping the water from storage tank into the reactor, but water level in the reactor is maintained by means of a separate neoprene-rubber diaphragm pump and a magnetically controlled return valve. Both the pump and the valve are controlled by the water-level indicator in the reactor tank. This indicator only covers a range of about 250 mm, the middle of this range corresponding to a level 100 mm above the uranium in the fuel rods. This level is normally maintained automatically, but may be shifted to any point within the range by resetting a scale in the control room. The regulating system is sensitive to a change of a millimeter in water level.

Reactor Control

Controlling a reactor essentially involves maintaining a balance between emitted and captured neutrons at a

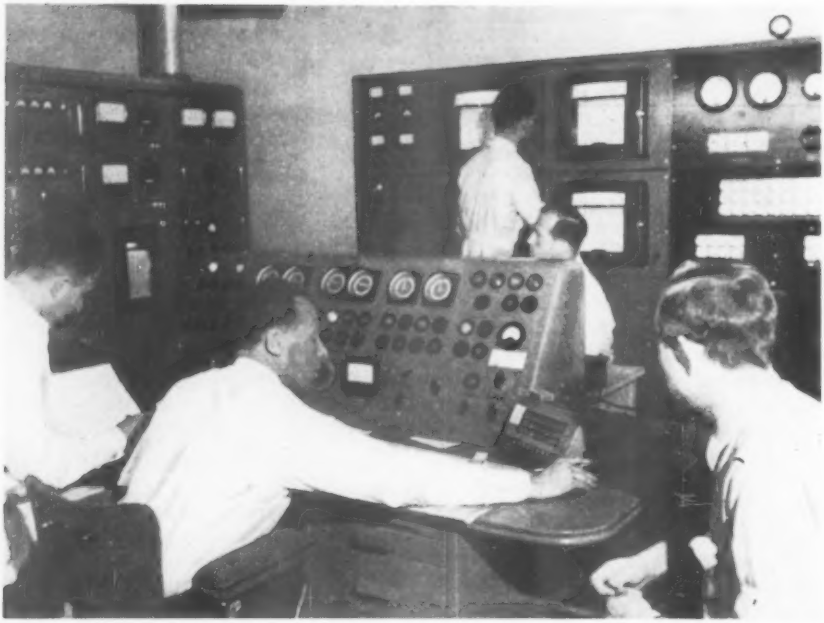

FIG. 11. Control console located in center of control room

chosen level of neutron activity. This calls for a neutron detector to control introduction of neutron-absorbing material into the reactor as a function of neutron density at the point of detection.

As in similar reactors, the neutrons escaping from the reactor core are used for control. These neutrons are detected by BF_3-filled ionization chambers placed just outside the reflector (Fig. 3). A current proportional to neutron flux is generated in the chamber circuit and is used to activate winching mechanisms that move neutron-absorbing cadmium plates in and out of the space between the reactor tank and reflector. If the neutron density diminishes, the control plate is pulled out; if it increases, more of the plate is pulled in.

In the Kjeller reactor, complete control and supervision of neutron activity is achieved with six BF_3 chambers and four cadmium plates.

Control plates. When the four plates are fully retracted, they rest in slots in the concrete below the reactor, and the reactor is divergent with a safe doubling time. When pulled into the space between the reflector and reactor tank, they move into the region of high neutron flux, and the reactor becomes subcritical. Two of these plates are used in controlling the reactor; the other two act as emergency shut-offs. Any one plate pulled all the way in will make the reactor subcritical.

All four plates are 1,300 mm long and 350 mm wide. The 1.7-mm cadmium sheet is riveted between two 4-mm aluminum plates. The control plates are guided by 8-mm steel rods (Figs. 3, 4) stretched by spring tension between anchor points at the tank support, through the slots in the concrete to anchor points in the basement roof as shown in Fig. 7.

The plates are suspended by steel

wires that pass over pulleys and then through horizontal holes in the shield to winching mechanisms mounted on the outside of the shield. The weight of the plates is balanced by counterweights, but the counterweight for each shut-off plate is 9 kg heavier than the 17-kg plate unit. The shut-off plates are locked out of the reactor, but are pulled in in 1.7 seconds if the lock is released. Impact of the fall and overshoot of the control plate are taken up by air dampers.

Neutron chambers. Each of the six BF_3 chambers has a different function. One is directly coupled to a galvanometer and will indicate neutron flux even if the main power supply is cut off. Normally, neutron flux indicated by a second chamber is recorded in the control room.

Three of the chambers control the shut-off plates. If the power rises too steeply, one of these chambers trips the plates and then also trips the valve that dumps the heavy water into the storage tank. The other two can be set to trip the plates at any selected power level below maximum but do not trip the dump valve.

The output of the sixth chamber is used to direct the automatic control of one or the other control plate. Either control plate can also be operated manually.

Auxiliary monitoring. As it is important to know the radiation level in the immediate vicinity of the reactor, a monitoring system is set up in the reactor room. Three ionization chambers give a continuous record of gamma radiation and fast and slow neutrons around the shield.

To detect fission products escaping from the uranium in the fuel rods, a G-M counter is installed in the heavy-water circulating system. The purity of the heavy water is measured with a built-in resistivity cell. The air exhausted by the reactor blower and through the water-to-air radiator is also monitored.

Control-room apparatus. All electronic equipment is collected in a row of enclosed standard rack panels in the control room. The switching, fuse and current distributing panels and all temperature recorders are set into one of the walls.

The control console is arranged as part of a large desk in the middle of the room, as shown in Fig. 11. Loudspeaker intercommunication connects the desk to all points of importance in the reactor building.

Important features of the control system are interlocked so that the operator has to follow a set routine in starting up the reactor. All important circuit voltages can be checked from the control desk, and pilot lights indicate circuit conditions.

The positions of all four cadmium plates are indicated on the control console by means of Magslip indicators. The positions of the plates used to control power level are recorded, as are deviations from any preset power level.

Power level is shown on a large main instrument in the middle of the row of rack panels. The scale value of this instrument is indicated by an illuminated decimal scale factor. The factor depends on the position in the shield of the main recording chamber and on the grid resistor selected in its preamplifier. These selections are interlocked with the scale-factor indication. An instrument on the control console can be set to one, ten or one hundred times the sensitivity of this main instrument.

The power supply for all electronic equipment is stabilized. A 24-volt battery supplies current for holding magnets and d-c relays. This battery also can be used for emergency lighting.

Normally, the battery is trickle charged from the power line, but a gasoline-driven generator can also be used. —END

Uses and Limitations of a LOW-POWER NUCLEAR REACTOR*

As a research tool, the low-power reactor can serve many fields. This feature, plus its low cost and unclassified nature, has aroused the interest of many scientists outside the AEC. The diverse possibilities it presents to chemist, physicist, and life scientist alike are fully analyzed here

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A "LOW-POWER" NUCLEAR REACTOR is defined as one that operates at a relatively low power. Power levels of reactors now in use range from zero to many thousand kilowatts (*1*). A low-power reactor might be taken to be one operating at levels below, say, 100 kw.

Reactor Characteristics

The usefulness of a reactor depends on many factors other than the power level at which it operates. A small research reactor has as its primary and essential purpose the production of copious quantities of neutrons.

Fissioning of 3.1×10^{10} atoms of U^{235} per second produces 1 watt of power, and each fission, on the average, releases a definite number of neutrons. Obviously, therefore, the total number of neutrons produced and the power level of the reactor are directly related.

For most purposes, the number of neutrons that can be obtained at a given point is a far more important quantity than the total number in the system. Thus, the volume of the reactor is also a factor to be considered. For a given type of reactor, operating at a given power level, the neutron density is inversely proportional to the volume. From the standpoint of neutron flux, minimizing the volume in a reactor is essential. To achieve this, fuel highly enriched in the fissionable isotope, materials of construction having low neutron-absorption cross sections, and moderator and reflector of optimum characteristics are utilized.

If natural uranium is used as the fuel, it is impossible to construct a reactor having a volume smaller than several cubic feet. Two tons or so of uranium and a similar amount of heavy water or graphite are required to produce a sustained nuclear chain reaction. On the other hand, if uranium highly enriched in the U^{235} isotope is available, an accumulation of less than 1 kilogram, homogeneously dispersed throughout a spherical reactor core of less than 1 foot in diameter, can be arranged for operation at a power level of 10 or 20 kw, or more.

A reactor of large volume has an advantage over a small reactor in that

* Paper originally presented before the Twelfth International Congress of Pure and Applied Chemistry, New York, September 10, 1951. As presented, it dealt with uses of low-power reactors for only chemical research. For publication here, it has been expanded to include uses for biological and physical research.

the number and size of specimens that can be irradiated at a given time is larger. If the reactor volume is small, a specimen inserted for irradiation has a much larger relative effect on the over-all flux distribution than the same specimen would have in a reactor of large volume. In a large reactor, because of the limited average range of neutrons, the effect of absorbing samples placed in and around the reactor is largely limited to depression of the neutron flux in the local area of the sample, while in a small reactor the over-all flux level may be lowered. It is possible to overcome this disadvantage by providing excess reactivity in the small reactor, which is normally "absorbed" by extra control rods. The extra control rods may be replaced by samples to be irradiated when desired.

Another factor of importance in the design and utility of a research reactor is the degree of moderation incorporated. A moderator is a low-atomic-weight material intermixed with the fissionable fuel to assist in rapid reduction of fission neutron velocities to thermal velocities. Unmoderated reactors offer more difficult control problems, require larger amounts of fuel and, of more importance to the present discussion, provide a neutron flux composed almost entirely of fast neutrons. A well-moderated reactor requires less fissionable fuel, and the neutron flux is composed of approximately equal numbers of fast and thermal neutrons. In general, well-moderated, thermal or slow reactors are more useful and adaptable to general research purposes than are unmoderated, fast reactors. Natural uranium reactors, of course, must be well-moderated in order to sustain a nuclear chain reaction.

The temperature at which a reactor normally operates does not depend on the power level but rather on the rate at which the energy released is removed. Whether the temperature is high or low has little effect on the neutron flux except incidentally as the temperature affects such other characteristics as density and average neutron energy.

It is generally desirable, from the standpoint of safety, for the reactor to have a negative temperature coefficient; that is, the reactivity should decrease as the temperature increases. When this is the case, maximum availability of reactivity of the reactor for experimental purposes is achieved by maintaining a low temperature.

On the other hand, when a reactor is to be used in research investigations leading to power generation, a high temperature is necessary. In this case, attention must be given to efficient means of extracting heat, to coefficients of thermal conductivity, to composite effects of high radiation fluxes and high temperatures on materials, etc. These phenomena require high temperatures for effective study. In general, low-power research reactors are not operated at temperatures above 85° C.

A low-power research reactor, therefore, may be described as a small, well-moderated, low-temperature, high-flux unit, operating at power levels up to 100 kw or so. The homogeneous reactor at Los Alamos (*2*), the Raleigh reactor now under construction at North Carolina State College (*3*), the Zoe reactor in France (*4*), and several others now in operation (*5–7*) fall within this category.

In the homogeneous reactor at Los Alamos, 870 gm of U^{235} as uranyl nitrate dissolved in water in a stainless-steel spherical vessel 1 ft in diameter constitutes the fuel in this unit, which operates at a temperature of 85° C and a power level of 6 kw. The neutron flux produced is more than 3×10^{11} at the center of the reactor.

The Raleigh reactor will contain about 900 gm of U^{235} as uranyl sulfate in water solution in a stainless-steel cylindrical vessel 10¾ in. in diameter and 11 in. high. It will operate at

The Raleigh research reactor, currently under construction at North Carolina State College, will be described in a series of articles to appear soon in NUCLEONICS.

80° C and at 10 kw maximum power level. A surface flux of at least 10^{11} thermal neutrons and a similar flux of fast neutrons is anticipated. This reactor, which should be completed within the next six months, will cost approximately $100,000. About 13 tons of graphite will be used in the reflector and thermal column, and 13 tons of lead and 60 or 70 cubic yards of concrete will be used in shielding.

The reactor recently completed in Norway* is a good example of a research unit using natural instead of enriched uranium. The core consists of 2 tons of uranium metal in the form of cylindrical rods, suspended in 7 tons of heavy water. The heavy water serves both as moderator and as coolant, by circulation to an external heat exchanger. The reactor is expected to operate at 100 kw or more, with a flux of 3×10^{11}.

Reactors of these types can be used to provide assistance of several different kinds in scientific research investigations. As shown on the following pages, they can serve as a source of fission products, activated isotopes, neutrons and other radiations, and as a device of intrinsic interest.

As a Source of Fission Products

In some reactors, the fissionable fuel is in solid form, and is enclosed in a thin cladding of aluminum to prevent oxidation and corrosion of the fuel. The fission products gradually build up inside these sealed fuel elements as the reactor is operated. Eventually the element must be withdrawn and chemically processed for removal of the accumulated fission products. At such time of reprocessing, the accumulated fission products become available for whatever use may be desirable.

If the reactor contains a liquid fuel, the nonvolatile fission products accumulate in the solution, but the gaseous products must be continuously removed. The volume of gaseous fission products is very small and could be left to accumulate in the reactor for considerable periods, except for the large volume of other gases from the reactor which are simultaneously formed. The larger volume of gases, mostly hydrogen and oxygen, results from the radiation decomposition of water in the fuel solution. The decomposition gases, which must be removed continuously because of their large volume and their explosive nature, cannot be extracted without the intermixed volatile fission products.

The gaseous fission products can be separated from the decomposition gases (e.g., by recombination of H_2 and O_2 and condensation of the resultant water) and, theoretically, can also be separated from each other, if suitable chemical separation processes are known. Thus, the volatile fission products may become available for research uses as desired.

Samples of the nonvolatile fission products can also be made available by removing a portion of the fuel solution, extracting the fission products, and returning the fuel to the reactor. This process can be carried out immediately after the reactor has been operated, but only if adequate facilities for processing the extremely radioactive liquid are

* EDITOR'S NOTE: See the article on page 5 for a description of this reactor.

available. Thus, short-lived products can be obtained.

Both volatile and nonvolatile fission products can be obtained from the reactor with liquid fuel, provided the particular product element of interest has chemical properties permitting separation by reasonable processes. Fission products are also available from reactors with solid-fuel elements, but at greater inconvenience.

Several types of chemical research can be performed on or with these fission products.

Identity and characteristics of the fission products. Much quantitative information may yet be obtained on the yields of various fission products, and on the decay schemes of highly radioactive, as-formed, fission-product elements. For example, fission products that undergo a sequence of beta-decay steps before reaching a stable state have furnished the most convenient (in fact, almost the only) means of studying the chemical effects of nuclear recoil due to beta decay. This phenomenon has received little study, but potentially important information may be involved. For example, recoil due to beta decay may cause disintegration of the host molecule and may possibly lead also to activation and subsequent reaction of the molecular fragments (*8*). It has been suggested (*9*) that further exploration of the recoil effects of beta decay may provide added evidence on the behavior and existence of the neutrino.

Procurement of specific isotopes. Many isotopes sold by the Atomic Energy Commission are obtained by separation as a fission product from "used" nuclear fuel (e.g., strontium-90, cesium-137) (*10*). The elements technetium and promethium, in fact, are available in significant quantities from no other source (*11*, *12*).

As tracers, sources of radiation, etc. The use of fission products as sources of radiation and for other applications has been suggested by several authors (*13*, *14*).

As a Source of Neutrons and Other Radiations

The radiations from a reactor constitute the most useful of all tools furnished to the research scientist by this apparatus.

The whole vast and highly complex field of radiation chemistry, including the bewildering array of physical and chemical phenomena resulting from the passage of nuclear quanta through matter, is opened to the chemist who has the radiations from a reactor at his disposal.

The biologist not only finds a powerful new tool at his disposal, but also finds himself, as a consequence, confronted with an entirely new series of problems in biophysics.

The physicist suddenly is in possession of radiation in quantities undreamed of only a few years ago.

Unfortunately, these potentially valuable radiation tools cannot be used to good advantage without a great deal of attention to specialized methods and techniques. Consideration of the problems and possibilities of using radiation from a reactor in various types of research will perhaps make this clear.

In Chemical Research

When search is made of the published literature for accounts of research investigations in nuclear or radiation chemistry in which reactor radiations have been used, surprisingly few reports are found. Aside from the reports of explorations on the fission products and on the transuranic elements, which fall into a special class, only a handful of

reports exist dealing with chemical investigations involving radiation from nuclear reactors.

One does not go far in search of reasons for this. The number of reactors in existence scarcely exceeds a dozen, and access to them is quite highly restricted. The chemists who have been able to use existing reactors have been obliged to share the available radiations with physicists, metallurgists, and a variety of other scientists. In a large proportion of the time, also, the available radiation, as well as the scientist's time, has of necessity been used in engineering development programs of immediate importance rather than in basic explorations.

Aside from these causes, there are three others of a distinctly different nature: (1) Research into radiation chemistry has utilized alpha particles from radon more than any other single type and source of radiation, and there is a strong tendency to continue this use, even when reactor radiations are available. X-rays and γ-rays from natural sources have also been popular. Techniques are well worked out, and results may readily be compared with results obtained in prior experiments; hence, there is a tendency to continue in already existing patterns. (2) Well-established procedures for exposing samples to reactor radiations have not been developed, completely adaptable sample holders for exposure have not been designed, and hazards incidental to operation of the reactor are not widely understood. These factors have had at least some deterrent effect on widespread use of reactor radiations. (3) More important than these two causes are factors inherent in the nature of reactor radiation itself, which must be considered.

The fission process releases neutrons having average energies of 2 Mev. They are accompanied by two or three highly energetic γ-rays. In collisions with moderator atoms (in the usual thermal reactor), the neutrons eventually are slowed to thermal velocities, so that, as mentioned above, about half the neutrons crossing any given plane within the reactor core in a given time interval are of thermal velocities and half are of all other velocities up to the maximum produced in fission. Within the reactor, and emanating therefrom in all directions, is a blast of neutrons and γ-rays possessing widely different values of energy. In considering the use of this reactor radiation, two questions are immediately posed to the research chemist: (1) Are the chemical effects different for a given type of radiation having widely different values of energy? (2) Are the chemical effects different for different types (e.g., γ-rays and neutrons) of primary radiation?

To give as much of the fragmentary and incomplete answers to these two questions as are now known would require an extensive review. Primarily, basic effects of any bombarding radiation* involve recoil of atoms struck, rupture of molecular bonds, ionization of atoms, etc., regardless of the type or energy of the radiation. It is not surprising, therefore, to find situations in which different types and energies of radiation do produce similar results. For example, bombardments of methane and *n*-butane with alpha particles from radon and deuterons from a cyclotron produce essentially the same observable chemical effects (*20, 21*).

Though the basic interaction phenomena between bombarding radiations and target molecules are identical, differences in population density of events along the radiation path, different proportions of "ionizing" and "activating"

* Neutrons, in contrast to the charged particles, interact only by collision with nuclei in their paths. These collisions produce ionizing particles which, in turn, interact with the containing media to cause the same net effects that would have been obtained had the primary radiation been of ionizing nature.

events, etc., cause the net observable results to appear distinctly different (*22*, *23*). So distinctly different, for instance, are the observable effects of alphas and of gammas on water, that it was at one time believed that gammas had no decomposing effect at all on pure water (*24*).

One would conclude, therefore, that, except for a few types of research investigations in which the total complex reactor radiation could be used to good purpose, the objectives of most radiation chemical studies would generally be achieved best by use of a single type of radiation of a known, fairly narrow, range of energy.

A question of paramount importance is whether methods are available by which a reasonably monoenergetic beam of a single type of radiation can be separated for use from the heterogeneous reactor radiation. For neutrons of low energies (that is, up to a few thousand electron volts), there are several methods. For neutrons having higher energies, satisfactory separation cannot be achieved except in a few special cases.

Beams of thermal neutrons are easy to obtain and are more useful in research investigations than are neutrons of much higher energies. To obtain essentially "pure" thermal neutron fluxes, two processes are combined (*25*, *26*): (1) The complex radiation from the reactor is allowed to pass through 8 in. or so of lead or bismuth. This filters out most of the γ-rays without serious attenuation of the neutrons. (2) The emergent beam of neutrons, of widely divergent energies, is then allowed to diffuse through 6 or 8 ft of purified graphite. The neutrons rapidly lose energy by collision with carbon atoms in the graphite "thermal column," and are reduced to thermal equilibrium with surrounding carbon atoms. The thermal column of the Los Alamos homogeneous reactor, for example, yields a flux of well over 10^6 n/cm^2/sec, in which the ratio of slow to fast neutrons is 90,000:1 (*2*). Thermal columns, in general, should provide fluxes of from 10^6 to 10^8 n/cm^2/sec for research purposes.

There are various means of obtaining neutron beams of fairly narrow energy spread, with average velocities considerably above thermal. Mechanical velocity selectors, consisting of a sequence of slotted, rotating disks synchronized to permit passage only of neutrons of a predetermined velocity, with those of all other velocities being trapped, have been used with fair success for neutrons with energies up to 1,000 ev or so (*27*, *28*).

Crystal spectrometers have also been used successfully to divide a heterogeneous beam of neutrons into component beams of narrow ranges in energy (*29–31*). Neutrons are diffracted by a suitable crystal through angles of reflection which are inversely proportional to the neutron velocity. Hence, by appropriately placed crystals, neutrons of a given energy are diffracted to a direction different from that of neutrons of all other energies. This technique is useful when neutron energies up to 100 ev or so are needed.

There are numerous other techniques and devices for obtaining neutron beams of desired characteristics from the reactor. These include, among others, time-of-flight velocity selectors (*32*), combinations of filter materials having different resonant absorption characteristics, and primary reactor radiations used to initiate a nuclear reaction in a material yielding a characteristic radiation of desired type and energy (*26*, *33*).

There is one unfavorable factor inherent in all schemes for securing homogeneous beams of radiation from a reactor. The intensity in the homogeneous beam is tremendously reduced from that in the original heterogeneous

beam. From a reactor possessing an internal flux of 10^{12} n/cm²/sec, one may be able to obtain 10^6, 10^4, or even perhaps only 10^2 n/cm²/sec of a particular energy. Fluxes of this magnitude constitute a luxuriant amplitude, compared to those available only a few years ago.

By a variety of devices and techniques, then, a low-power nuclear research reactor can provide adequate beams of sufficiently reproducible and homogeneous radiation to permit systematic exploration of many types of chemical research. Some of the types are suggested below. Not all the types in this illustrative list have been, but all and more could be, investigated by the use of reactor radiation.

Differences in distribution of product elements from differently initiated fissions. When fission of a given isotope, U^{235} for example, is initiated by different types or energies of radiation, different proportions of particular elements are found in the fission products (*34*). Further information on this phenomenon may lead to clearer understanding of the fission process itself.

Primary products, and subsequent behavior of primary products, formed by irradiation of chemicals. The nature of the primary effect of irradiation on chemical substances, particularly on water and aqueous solutions, has long been a subject of intensive study (*35, 36*).

It is now believed that H atoms and OH radicals are the effective products resulting from irradiation of water molecules. There is still much work to be done before the picture is clear on the chemical actions occurring subsequent to formation of primary products, on the role of additive ingredients (inert or otherwise), and on the chemical basis of indirect action and energy transfer within molecules (*37–39*).

Polymerization effects of radiation. Studies of the irradiation-induced polymerization (*40, 41*) of gases and liquids (such as styrene, benzene, and cyanide compounds), the number of molecules affected per "interaction event," the role of additives, and the differences in effects resulting from use of different types of radiation, are of keen interest to researchers. Studies in this field have led not only to clearer ideas of the complex factors in the fundamental processes involved, but also to better understanding of such practical matters as the operation of Geiger counters (*42*) and the formation of "gunk" inside electron microscopes.

Phenomena associated with recoil of atoms. When a relatively stationary atom is struck by a high-energy particle, or when an atom recoils violently as a highly energetic particle is ejected, a number of events may ensue. Molecular bonds may be broken, variously charged or neutral fragments may be formed, etc. Investigations of these phenomena can lead into several special fields. Examples are research on separation of (n,γ) activated atoms from nonactivated ones by the Szilard-Chalmers process (*43, 44*), mechanical and physical effects due to atomic displacements in solids, Wigner effect, separation of isotopes by (n,γ) recoil (*45*), and other phenomena (*8, 46*).

In Biological Research

Many of the comments made above relative to the use of reactor radiations in chemical research apply also to their use in biological research. X-rays, and other radiations to lesser extent, have been customarily used to explore the biological effects of radiation. Widespread use of reactor radiation in biological studies has not been made, for much the same reasons as those mentioned above. A number of significant studies have been made, however, and the use of reactors is steadily increasing.

Several of the general types of bio-

logical research which can be undertaken with reactor radiations are:

Physiological effects and damage caused in animals by radiation. Exploration of the injury threshold, lethal dosage, effects on body organs (*47*), heredity effects (*48*), etc., can be made. In many investigations relative to atomic warfare and civil defense, the effects of the total radiation produced by a reactor are of interest. In other studies, the use of homogeneous, monoenergetic beams of radiation is necessary.

Effects of radiation on biochemicals ("chemical protection" from radiation). Investigations in this field, which really form a portion of the larger field of radiation chemistry mentioned above, have opened up entirely new possibilities in the considerations of radiation sickness and its treatment (*49–51*).

In Physical Research

Radiations from a reactor have been used more extensively for research in physics than for research in any other field. For maximum utility in physics research, as in chemistry and biology, the "shotgun" reactor radiation must be separated into homogeneous beams. In this case, the development and exploration of techniques for achieving this separation are themselves fertile field of research.

There are several general types of physical research in which reactor radiations are used as tools.

Microscopic nuclear phenomena. Over the range of neutron energies in which separation into monoenergetic beams can be achieved, numerous valuable explorations into nuclear physics are possible. Among them are investigations into threshold energies of nuclear reactions, nuclear cross sections (*52*, *53*), yield ratios in reactions with multiple products, inherent properties of radiation [e.g., polarization (*54*) and decay of neutrons], resonance absorption characteristics (*55*), etc.

Macroscopic nuclear phenomena. Again, where homogeneous monoenergetic beams are available, the study of their interaction with matter in macroscopic quantity is of great interest. Attenuation and "transport" of radiation of various types and energy in different materials, radiation reflectivity, radiation-induced luminescence and fluorescence, effects of radiation on thermal and electrical conductivity and on other properties (*56*), and determination of crystal structure by diffraction (*57*) come under this type of exploration.

As a Device of Intrinsic Interest

Aside from the tools, such as irradiated chemicals and intense beams of radiation, which a reactor places at the service of research scientists, the behavior, methods of use, and characteristics of nuclear-chain-reacting accumulations of fissionable fuels are themselves matters of great intrinsic interest.

Reactor characteristics. Much more information must be gathered before the complete "kinetics" of a reactor can be understood or the complete behavior of a given reactor predicted in advance. At the present time, dependable calculations of conditions and characteristics in chain-reacting systems can be made only for simple, idealized situations (*58*), and the effect of various necessary components in a practical system can be predicted only approximately by semi-empirical methods.

Reactor characteristics and the effect of various factors on the behavior of chain-reacting systems offer a fertile field of exploration. The topical investigations suggested below could, in general, be undertaken with any low-power research reactor, though some

might be more easily explored with a reactor having a particular fuel distribution.

Radiation distribution. In the chain-reacting assembly, almost all types of radiation are present. If the reactor is well moderated, the various types of radiation will be present with all values of energy up to the maximum. Investigation of the space and velocity distributions of radiation, in the core and in the surrounding media, and the effect on these distributions of particular conditions in a given reactor is an important task.

Temperature effects. The effect of temperature on reactivity constitutes one of the most important considerations in reactor design. The over-all temperature coefficient is due to the composite effects of several factors: density of fuel, moderator, coolant, and reflector; formation of vapor bubbles in constituent liquids; existence of nuclear resonance in particular energy regions; etc. Many such factors can be explored with small research reactors.

Transient phenomena. The nature and cause of fluctuations in the steady-state operation of a reactor, and the time factor in transference of a local disturbance to other portions of the reactor, are matters of interest.

Inhomogeneity effects. Knowledge of the local effects of voids in the core or in the reflector, of cooling coils and coolant, of control rods, of inserted samples, of nonhomogeneous distributions of fuel, etc., on radiation distribution is important to the control of reactors, to the use of reactors in accurate irradiation of samples, and to the calculation of absolute power levels at which a given reactor operates.

As a Source of Activated Isotopes

Radiations from the reactor can be used to produce activated chemicals which themselves are not of primary interest but can serve as tools in achieving other research goals. Two major types of research fall within this category.

Preparation of tracers. Many radioactive tracers can, of course be obtained from AEC sources. In particular cases, however, where short-lived tracers, or where in situ manufacture of a tracer by irradiation is desired (*15*), access to the facilities of a reactor located nearby is highly convenient.

Chemical analysis by activation. Numerous elements with suitably high (n,γ) cross sections and suitable half-life decay periods for their activated isotopes can be detected and quantitatively measured in a composite sample containing many other ingredients (*16–19*).

DISCUSSION

No attempt has been made to list above all types of explorations possible with a low-power research reactor.

It should be clearly understood that reactors have not necessarily been used to date on every type of research problem mentioned above.

Complete exploration of some of the research projects listed is not possible with a low-power reactor, even though partial exploration is possible. For example, thorough investigation of the physical effects of radiation on solid materials can be made only with reactors furnishing neutron fluxes of 10^{13} or 10^{14}, which is beyond the range of reactors being considered. It is possible, however, to make partial, and valuable, investigations of such problems with fluxes of 10^{11} or 10^{12}, which are

available from small research reactors.

It should not be supposed that other sources of radiation and already-developed types of nuclear accelerators will be supplanted by the low-power nuclear reactor. Instead, each will be a supplement to the other. The nuclear reactor, however, will assume an increasingly prominent place as methods are improved for isolating and using homogeneous, monoenergetic beams of radiation from the reactor.

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Radioisotopes Techniques Conference Papers

From the many excellent reports of new applications and research with radioisotopes presented to the Radioisotopes Techniques Conference at Oxford, England, from July 16–20, 1951, NUCLEONICS has selected for publication a group of papers of particular interest to its readers. Four of these papers appear on the following pages; others will be published in later issues. NUCLEONICS' general report on the proceedings of the Conference was published in the October issue, pages 5–16, in a special article by J. L. Putman.*

Oxford, 1951

Estimation of Tritium and Some Preliminary Experiments on Its Use as a Label for Water†

Deuterium is often used to study incorporation of the hydrogen from body water into certain compounds. Tritium may prove to be a more useful label because it can be assayed conveniently in lower concentrations and smaller samples. Research with body water from rats is cited. Butane is used as the assay medium

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TRITIUM, the hydrogen isotope with a half-life of about 13 years, is potentially very useful, especially as an auxiliary label for carbon chains. Its extremely soft beta radiation, however, makes it difficult to assay.

Described here is a method for determining the tritium in radioactive water by allowing the water to react with an excess of dry butyl magnesium bromide and counting the resultant tritiobutane in the Geiger region of a gas counter. This method has been applied in an experiment to compare the uptake of tritium and deuterium from doubly-labeled body water into fat of the mammary gland and liver in the rat. It usefulness in other research is also noted.

Counting Technique

Although the counting of solid samples of tritiated compounds would be expected to have extremely low efficiency, a method has nevertheless been devised by Eidinoff and Knoll (*1*) in which a windowless, methane-flow-type counter is operated in the proportional region. Using a tritium-labeled steroid, they found an infinite thickness value of less than 1 mg/cm² and, comparing with gas-counting data, calculated the efficiency as about 2.6% for an 8-mg sample.

They point out that solid counting will be useful primarily for counting

* Proceedings of the conference, arranged by the British Atomic Energy Research Establishment, will be published by H. M. Stationery Office, London.

† An abridged version of this paper was presented at the Radioisotopes Techniques Conference, Oxford, England, July 19, 1951.

labeled compounds before using them in biological experiments; the activity of metabolites will usually have to be determined by gas counting.

Tritium gas-counting techniques always involve the use of a hydrogen-containing gas as part of the counter filling. Water vapor, mixed with the usual argon-alcohol filling, has been used, but not successfully at partial pressures exceeding about 5-mm mercury (*2*). Hydrogen mixed with argon and alcohol vapor has been more widely used. However, it is reported (*3*) that considerable contamination of graphite-cathode glass counters occurs especially at high counting rates. This is thought to be due to exchange, under the influence of the discharge, of tritium with combined hydrogen in the walls of the counter. Hydrogen has the additional disadvantages that it is not easily generated quantitatively from water and is not condensed at liquid-air temperature.

Most workers would agree that an ideal method for the assay of tritium would make use of a hydrogen-containing gas with good counting properties in the Geiger region of conventional gas counters. The gas should be easily preparable in good yield from water and should be fully condensed at liquid-air temperature, thus facilitating its manipulation in a vacuum system. It should not contaminate the counter after counting for some time at moderate rates.

A great improvement on existing methods* was made last year when White, Campbell, and Payne (*4*) published their method for the preparation and counting of tritiomethane. Radioactive water is allowed to react on the 100–200 mg scale with aluminum carbide. Although counters filled with methane so prepared showed no Geiger region, these workers found that they were able to count it with high efficiency in the proportional region. No counter contamination was observed.

For the work we wished to do, however, this method appeared to have several disadvantages: In the first place, it seemed doubtful whether the method could be scaled down to deal with the small quantities of water that we expected to have to assay. In the second place, since methane is not condensable at liquid-air temperature, it would be difficult to measure out aliquots accurately and transfer them quantitatively to the counter. Finally, we preferred, if possible, to use a gas that could be counted in the Geiger region.

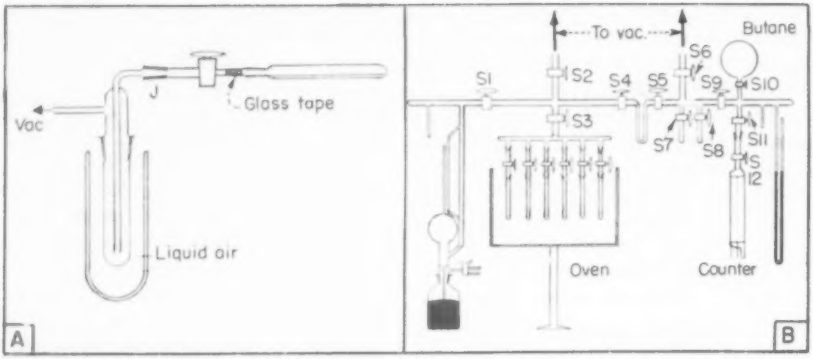
The reaction of water with a Grignard reagent furnishes a means of producing almost any hydrocarbon, including methane, containing in its molecule one of the two water hydrogen atoms. Powell and Reid (*5*) reported in 1945 that butane is a good Geiger-counter gas, but they gave only scanty details and no information as to the length and slope of the plateau. They actually prepared tritiobutane, however, and counted it in the course of their work on the isomerization of butanes.

Normal butane is fully condensed at liquid-air temperature, and in our apparatus it was found to have a vapor pressure of about 13 mm at −78°. It is therefore easily freed from much less volatile components such as water by distilling it through a U-tube cooled with solid carbon dioxide.

Carbon-14 is usually assayed in this laboratory by means of a Pyrex glass gas counter with a graphite cathode (20th Century Electronics GA.10) connected to the electronic equipment through a Neher-Harper quench circuit. This was the apparatus we first used to test butane as a counter gas.

The first counter tried with a butane

* *Note added in proof:* A method for the assay of tritium using tritiomethane prepared by the action of 250-mg samples of water on methyl magnesium iodide in butyl ether solution has recently appeared [C. V. Robinson, *Rev. Sci. Instr.* **22**, 353 (1951)].



Setup for converting radioactive water containing tritium to butane on a 10-mg scale

filling showed an excellent characteristic. At 14 cm mercury pressure, there was a well-defined Geiger region with a long, flat plateau. Unfortunately others, apparently identical, showed no plateau at all but gave large numbers of spurious counts. In fact, only about one counter in five of this pattern was any good.

The manufacturers were consulted and at their suggestion counters with passive iron cathodes were tried (GA. 10 M). A higher proportion (about three in five) of these counters showed a good characteristic, provided the cathode was thoroughly outgassed. This meant several hours' baking in vacuo at 300° and, for some of them, the application of the Tessla coil. A good counter of this pattern containing *n*-butane at 14 cm mercury pressure has a starting voltage of 3,000 volts and an almost flat plateau of 600–800 volts.

Although butane might be expected to be a self-quenching gas, it was found not to be so on our equipment, and the quench circuit is essential. The failure of some counters with a butane filling seems to be due chiefly to the condition of the cathode, but it is not known what this condition is. In one case, it was found that baking out in hydrogen at 300° followed by baking in vacuo produced a good counter from one that was previously useless.

A GA. 10 M counter has an effective cathode length of 20 cm and a diameter of about 2 cm. When filled with gas at a pressure of 14 cm mercury, it contains about 12 standard ml, which is the volume of butane theoretically obtainable from the action of 10 mg water on butyl magnesium bromide. This is also about the amount of water obtained from the combustion of convenient quantities of biological materials. For this reason, the method developed for carrying out this reaction is on the 10-mg scale (*6*).

Production of Butane

About 1.5 ml of a 2*N* ethereal solution of *n*-butyl magnesium bromide is pipetted rapidly into a 10-m tube with a B.10 socket. The tube is then attached to a stopcock carrying a B.10 cone. The total space beneath the stopcock is about 15 ml, which is more than enough to accommodate the butane to be produced. See sketch *A* above. Both joint and stopcock are lubricated with silicone grease and a small wad of glass tape is inserted beneath the tap to protect it from splashes during the removal of the ether.

The contents are frozen in liquid air,

the tube evacuated, and the ether distilled off in vacuo with gentle warming. It is best to do this operation with the tube in the horizontal position to reduce splashing. Since a very high vacuum is not necessary, this may be done on a subsidiary vacuum line without greasing the joint J.

After the ether has been removed, the unit is attached to the manifold as shown in sketch *B*, together with a number of others similarly treated and baked off at 120° under high vacuum on open pumps for two hours. This removes the last traces of ether. If the stopcock is then closed and the heating continued for a further hour, not more than 150 μl of gas should be formed; that is to say, the blank should not exceed 1.5% of the butane to be produced.

The tube is allowed to cool and 10 mg of radioactive water condensed in by means of liquid air. The tap is closed, and the tube heated for an hour at 120°. Tritiobutane is produced almost quantitatively and is purified by distilling through a U-tube cooled to −78°. It has been found that the yield is reduced if the solution from which the dry reagent is prepared is kept too long, and it has been found best to prepare fresh solution at least once a week.

Butane prepared by this method has been examined by means of a mass spectrometer. A comparison of the mass spectrum with that of an authentic sample of *n*-butane and of a 6% ether-butane mixture indicates that the amount of ether in the "synthetic" butane is estimated as less than 0.04%. Curiously enough, the mass spectrum of the small amount of gas produced in the blank indicates it to be chiefly *butene*, but the way in which it is formed has not been traced.

The activity of the butane is determined by condensing a measured sample into the counter and adjusting the pressure to 14 cm with inactive butane from a reservoir. It has not been found to contaminate the counter even after counting for some time at rates of about 2,000 cpm, and a constant background is observed with inactive fillings.

The method has been checked by assaying a stock solution of radioactive water (containing a nominal 2 μc/ml) and various dilutions of it. The results are shown in Table 1. Volumes of gas greater than 1 ml were measured manometrically in the previously calibrated space bounded by the stopcocks S9, S10, and S11 (sketch *B*). Volumes of 1 ml or less were measured in the Mc-

TABLE 1
Specific Activity of Butane Obtained from Various Dilutions of Stock Radioactive Water*

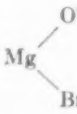
Water sample (*% stock*)	*Volume of butane assayed* (*ml*)	*Activity* (*cpm*)	*Specific activity* (*cpm/ml*)		*Error* %
			Obs.	*Calc.*	
10	8.85	1,353	153	153	0
20	3.70	1,152	312	306	+2.0
40	2.59	1,554	600	612	−2.0
60	1.005 0.860	908 802	915	918	−0.33
80	0.805	972	1,210	1,224	−1.7
100	0.645	987	1,530	.....	.....

* Quoted from R. F. Glascock (*6*)

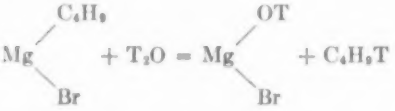
Leod gage. The calculated activity shown in the fifth column of Table 1 is based on the experimentally determined activity of the stock solution itself. In all cases, there is good agreement between the calculated and observed specific activities of the gas samples.

It would obviously be of advantage if a fairly large excess of dry Grignard reagent could be deposited in a tube and then used repeatedly for different assays until exhausted. Unfortunately, this is not feasible.

By generating butane first from radioactive water and then, after an hour's baking on open pumps, from inactive water it was found, in several experiments, that the second samples contained varying small amounts of activity. This is thought to be connected with the fact that the production of butane is never quite quantitative. This contamination could also be due to exchange of hydrogen in the new water with tritium in the magnesium compound, conventionally represented as



which would become labeled during the previous reaction:



Which, if either, of these possible reasons is the true one has not been ascertained.

Experiments with Labeled Body Water

Although tritium will probably be most useful for labeling compounds difficult to synthesize from C^{14}, some preliminary experiments on its use as a label for hydrogen ions have been carried out. A comparison of the in vivo incorporation of tritium and deuterium from doubly-labeled body water into fat of certain organs was tried.

An interesting feature of such experiments is that they might shed light on the validity not only of tritium but also of deuterium as labels for hydrogen ions. For, if the uptake of tritium differed markedly from that of deuterium, then this might imply that the uptake of deuterium differs by an even greater amount from that of ordinary hydrogen.

Two lactating female rats were each given by stomach tube 25 gm of heavy water containing 2 mc of radioactive water. They were sacrificed after 24 hours, and the total fatty acids of mammary gland and liver isolated by the usual methods. These fatty acids were combusted and the combustion water assayed for both isotopes [deuterium by the falling-drop method (7)]. The results are shown in Table 2. If both isotopes were incorporated to exactly the same extent, then the figures in the last column would be unity. If less than unity (as they all are), then the incorporation of tritium is relatively less than that of deuterium.

It must be emphasized that this is only a preliminary experiment and that it has several undesirable features which it is hoped to avoid in later work. The chief of these is the deuterium content of the blood water, which was made undesirably high so as to get a measurable amount of deuterium into the fatty acids within a short time. This may, in fact, vitiate the whole experiment, and the results should be treated with reserve.

Whether or not the incorporation of either of the isotopes is the same as that of ordinary hydrogen, it is nevertheless valid to compare the metabolic activity of similar tissues by measuring the uptake of these isotopes. It has been deduced from respiratory data obtained in this laboratory that insulin added in vitro stimulates the incorporation of

TABLE 2

Incorporation of Deuterium and Tritium into Fatty Acids from Doubly-labeled Body Water*

[Each of two rats received 2 mc TOH and 25 gm D_2O (99.7%) by stomach tube and were sacrificed 24 hr later]

Sample	Tritium		Deuterium		
	cpm/mg H_2O	*As % of dose (x)*	*Atom % excess*	*As % of dose (y)*	$\frac{x}{y}$
Administered water	7×10^4	100	92	100	1.000
Rat (a) blood water	6.3×10^3	9.0	8.30	9.02	0.998
Rat (a) mammary gland fatty acids	40.8	0.058	0.13	0.14	0.41
Rat (b) blood water	5×10^3	7.15	8.0	8.7	0.82
Rat (b) mammary gland fatty acids	27.1	0.039	0.05	0.054	0.74
Rat (a) + (b) liver fatty acids	46.5	0.067	0.08	0.087	0.77

* Unpublished work of W. G. Duncombe and R. F. Glascock

acetate into fat by rat mammary gland slices metabolizing glucose plus acetate (*8*). This deduction has now been confirmed by incubating lactating mammary gland slices in a suitable medium containing C^{14}-labeled acetate and radioactive water (*9*). The uptake of both isotopes is markedly increased by the presence of insulin. These results, shown in Table 3, not only confirm the insulin effect but, more generally, illustrate the ability of mammary tissue to synthesize fatty acids from small molecules.

Elimination of Contamination

Gas-counting techniques have been used in all the work described in this paper. Only a single combustion is necessary for the determination of both tritium and C^{14} in doubly-labeled compounds. Also, only small quantities of low-specific-activity metabolic products have been dealt with, 10-mg samples being combusted in a furnace connected with a vacuum train and the carbon dioxide and water stripped out of the oxygen stream by means of liquid-oxygen-chilled traps. The carbon dioxide is then separated from the water by sublimation at −78° in vacuo and counted by the method of Brown and Miller (*10*). The water is converted to butane.

The apparatus is checked occasionally by combusting a sample of inactive glucose, but no significant activity in

TABLE 3

Effect of Added Insulin on in Vitro Incorporation of C^{14} from Carboxyl-labeled Acetate, and of T, from Radioactive Water, into Fat of Rat Mammary Gland Slices*

Expt. No.	C^{14} in fatty acids (cpm/mg C $\times 10^{-3}$)		T in fatty acids (cpm/mg combustion water)	
	Insulin (−)	*Insulin* (+)	*Insulin* (−)	*Insulin* (+)
1	74	136	435	1,630
2	71	97	330	417
3	38	84	131	346
4	27	96	162	326
5	35	82	158	367
6†	5.9	8.1	134	380
7†	2.8	12.5	46	223
8†	5.5	12.0	117	306

* Quoted from J. H. Balmain *et al.* (*9*).
† 1 μc sodium acetate in 20 ml medium in these experiments; 10 μc in all others.

the resulting carbon dioxide and water has ever been found. This virtual elimination of contamination is probably due to the fact that the oxygen stream is continuously passed through the hot furnace whether it is in use or not. There is a danger of contamination (and hence of errors) in the butane-generating apparatus, however, since butane is appreciably absorbed in tap grease. If active butane is stored for any appreciable time in a side arm, it is necessary to clean and regrease the stopcock before using it for another sample. No measurable contamination of the grease is caused by merely passing active butane through the apparatus.

• • •

Thanks are due to Dr. A. T. Cowie for administering the labeled materials to experimental animals, to Dr. D. H. Tomlin for the analyses made in the Agricultural Research Council's mass spectrometer in the Physics Dept. of the University of Reading, to 20th Century Electronics, Ltd., for their help in designing and selecting counters, and to the Calor Gas Company, Ltd., for specially preparing the pure butane. The technical assistance of Mr. B. W. E. Peaple is also acknowledged.

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A Study of Tracer Methods for Assessing Wear of Wire-Drawing Dies*

Irradiation of tungsten carbide dies was used to provide a means of measuring die wear. The activity of die debris adhering to drawn wires was then quantitatively measured by Geiger counters

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IN THE WIRE INDUSTRY, the life of wire-drawing dies is an important factor. Production has to be interrupted when worn dies are changed, and the process of opening out a worn die and repolishing is an expensive and skilled operation. A lubricant is used in the wire-drawing process primarily to reduce friction and wear at the die surface, to minimize heating of the die, and to ensure a satisfactory product. Other properties being acceptable, industry will favor the lubricant giving the longest die life.

An experimental vertical drawbench, as shown in Fig. 1, is used at Thornton

* Paper presented at the Radioisotopes Techniques Conference, Oxford, England, July 19, 1951.

TABLE 1
Data for Radioactive Constituents of Die

Active isotope	*Half-life*	*Specific activity mc/gm after one week's irradiation (reactor factor 1.0)*	*Radiation*		*Total activity in die, mc (based on 5.45 gm W and 0.55 gm Co)*
			β (Mev)	*γ (Mev)*	
Co^{60}	5.3 years	2.1	0.3	1.1 1.3	1.2
W^{185}	76 days	0.27	0.48 0.69	0.13	1.47
W^{187}	24 hours	90	1.33 (30%) 0.63 (70%)	0.69 0.62 *et al.*	490

Research Centre for studying the friction-reducing properties of wire-drawing lubricants. In it, lengths of approximately 6 ft of 17-gage copper wire are drawn through an 18-gage tungsten carbide die by the action of a weight. It was decided to attempt to adapt this apparatus to tests for die-wear measurements using a tracer technique.

Calculations based on the increase in the bore of dies in industrial use indicate that the die wear to be expected is of the order of 2×10^{-8} gm/ft length of copper wire. If the assumption were made that all, or a constant proportion of, the die-wear debris was retained at the surface of the wire, it seemed that a radioactive-tracer technique would prove feasible for detecting the minute amounts of wear products involved and might be applied to the measurement of die wear. The die,* being composed of tungsten carbide sintered in a cobalt matrix, readily lends itself to such a method, because its constituents form suitable radioisotopes under neutron bombardment (Table 1).

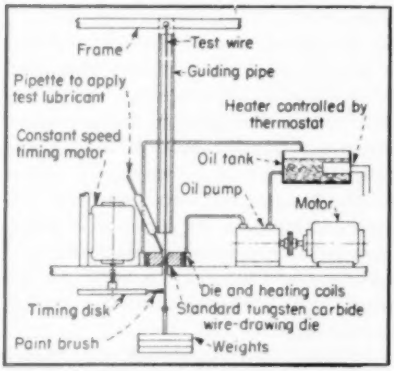

FIG. 1. Sketch of vertical drawbench

Development of Technique

It was decided to use the short-lived high-activity tungsten isotope W^{187} rather than to allow it to decay and then to use the other isotopes. The die insert, which weighs approximately 6 gm, is composed mainly of tungsten and cobalt in the ratio of about 10:1. After irradiation for one week, it has an activity of about 500 mc, which necessitates adequate shielding. The die is accordingly housed in a lead castle that reduces stray radiation to a safe level both when in transit and when in use on the drawbench.

Autoradiographic method. The autoradiographic method for detecting wear debris on the drawn wire was investigated first because it is simple to

* The complete die consists of a tungsten carbide insert, through which the wire is drawn, held in a steel case. In this paper, the term "die" generally refers to the insert only.

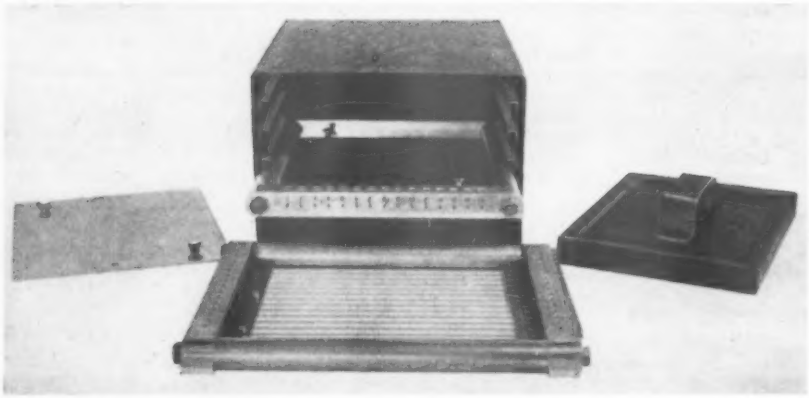

FIG. 2. Apparatus for autoradiography with wires containing wear debris from radioactive wire-drawing dies

use. Copper wires drawn through the irradiated die were cut into lengths of approximately 10 in. and placed in contact with X-ray film in a light-tight holder.

The first holder consisted of a Tufnol (phenol-formaldehyde) plate with grooves milled on one face to accommodate the lengths of drawn wire, the top surfaces of the wires being flush with the lands of the plate, on which lay the film held down by a light-tight spring-loaded lid. Preliminary tests showed that when a film was placed in direct contact with the Tufnol, a faint image of the lands resulted. This was attributed to chemical interaction between the Tufnol and the photographic emulsion. The effect could be prevented by placing a thin polystyrene sheet between the film and the Tufnol. Because this holder suffered from a number of practical defects (e.g., the wires, which were rarely quite straight, were easily displaced from the grooves in the plate), a new fixture was constructed in which lengths of wire could be securely clamped at either end, and straightened and aligned in one plane by being tightened over two parallel transverse rods (Fig. 2).

The holder was loaded with wires and Ilford Industrial "A" film, placed in a light-tight box, and a suitable exposure given. For wires autoradiographed immediately after drawing through a freshly irradiated die, an exposure time of 18 hr gave workable image densities.

Typical autoradiographs show that wear, as revealed by the radioactive deposits, is erratically distributed along the wires. For a 6-ft length of wire, the drawing speed varies from 0 to about 650 ft/min, but the autoradiographs disclose no trend in wear rate.

The autoradiographs reveal three distinct types of wear deposits: (1) fairly uniform wear deposits showing as a general background along the positions occupied by the wires, tentatively attributed to cobalt; (2) discrete spots, of much greater intensity than the general background, occurring either singly or as nonuniform groups, tentatively attributed to particles of tungsten carbide; and (3) groups of uniformly spaced discrete spots, extending over about an inch of wire, occurring occasionally.

But for the presence of the 76-day tungsten isotope W^{185}, the wear debris

contributed by the tungsten could be differentiated from that contributed by the cobalt in a matter of days, by allowing the 24-hr tungsten isotope W^{187} to decay to a negligible level, and taking further autoradiographs which should indicate the cobalt wear debris. Because W^{185} is present, however, it is necessary to store the wires for about nine months to allow the ratio of the activity of W^{185} to that of Co^{60} to decrease from the original value of about 2.5:1 to a value of about 0.2:1.

An autoradiograph taken after such a period still gave evidence of uniform wear along the wires, but the intensities of discrete wear spots had decreased to a relatively greater extent, supporting the hypothesis that they were caused by particles composed chiefly of tungsten.

The order of magnitude of the wear rate has been estimated by comparing the image densities of typical autoradiographs with the image densities produced by radioactive sources of known activities. Two independent estimates of the average wear were made in this manner by members of the Atomic Energy Research Establishment at Harwell, and the Research Laboratory on the Physics and Chemistry of Surfaces, at Cambridge University. They gave values of 2×10^{-8} and 2.4×10^{-8} gm/ft of wire, respectively; the latter group also suggested a figure of 0.5×10^{-8} gm/ft for the minimum wear rate detectable on the autoradiographs. These figures are only order-of-magnitude estimates since they depend on the particular portion of the autoradiograph selected for the estimation. The closeness of agreement between them and the previous estimate from increase in die bore is almost certainly fortuitous.

Concentration and integration of wear debris. The erratic distribution and varying size of the wear-debris particles made it apparent that the autoradiographic method was not suitable for accurate comparison of different wear rates in that it gave a qualitative rather than a quantitative picture of the wear. The significant feature of the "wear picture" was the wide variation of the amount of debris between one short length of wire and another. It became apparent that it was necessary, therefore, to draw a much longer total length of wire and to integrate the wear products over this length to obtain a significant value for the mean wear rate.

A number of methods of aggregating the wear products from the wires and increasing the proportion of radioactive to inert material, to permit the use of a Geiger-Müller counter, were then considered as follows:

Chemical stripping. Stripping of the outer surface of the wire to remove wear debris, by a chemical method, was considered to have a number of practical disadvantages, e.g., it would be a time-consuming process, and there was a likelihood that it would require separate methods for isolating both tungsten and cobalt.

Stripping by oxidation. It was suggested that an oxide scale formed on the outer surface of the wire and subsequently removed would carry away the wear debris. A limited amount of work along these lines, however, failed to produce any reliable method of forming and then stripping the scale.

Electrolytic stripping. In this method, the wire, forming the anode of an electrolytic cell, was slowly passed through the electrolyte. The wear products were retained on the cathode, in the electrolyte, and in sludge, where they could be assayed separately. Active wires were passed through the electrolytic-stripping bath at a speed of about 0.5 ft/min with a current of 4 amp flowing between the wire and a concentric copper cathode $3\frac{1}{8}$ in. long. Five lengths of wire (approximately 30 ft total length) were stripped by this method, the diameter being decreased by approximately 6×10^{-4} in. An

TABLE 2

Test data: Electrolytic Stripping

Source	*Activity, c/sec*
Electrolyte	25
Sludge and deposit on cathode	85

autoradiograph of the stripped wire showed that most of the active debris had been removed. It was considered that complete stripping could have been achieved by suitable adjustment of speed and current. The electrolyte, copper cathode, and sludge were assayed with a thin-walled immersion-type Geiger-Müller tube and a count-rate meter, giving the activities shown in Table 2.

Helix method. During these experiments, the opportunity was taken to test a preconception that the radiation from the wires as drawn would be too weak to give a useful counting rate; in fact, a counting rate well above background was obtained. It was, therefore, decided to investigate the activity recorded when the G-M tube was inserted into a well-fitting close-wound helix formed by a single length of wire. The first wire assayed in this manner gave a readily detectable counting rate of about 45 counts/sec. The result obtained by stripping the active debris from five lengths of wire gave an average activity per wire of about 22 counts/sec, but no quantitative conclusions can be drawn from this comparison because some difference in activities is to be expected from different geometrical arrangements, different amounts of wear products on individual wires, and incomplete electrolytic stripping.

One limiting factor in the use of the helix method was foreseen in unevenness in the distribution of wear products around the circumference of the wire. Tests were made to assess the importance of this effect, with the aid of a Perspex fixture which located thirty short equal sections of wire in a squirrel-cage formation coaxial with the G-M tube. The total length of wire was about 12 ft. By rotating the wires in their locating grooves through 180° about their own axes, tests were made of the variation in circumferential distribution of wear particles, typical count-rate-meter readings being shown in Table 3.

TABLE 3

Test data: Circumferential Wear Distribution

		Count-rate-meter readings			
Lubricant	*Test No.*	*Mean readings c/sec*	*Number of readings*	*Standard deviation c/sec*	*Remarks*
A	1*a*	13.51	60	1.65	
A	1*b*	14.35	60	1.53	Same wires as Test No. 1*a*. Each wire rotated through 180°
D	2*a*	33.40	60	3.24	
D	2*b*	29.07	66	5.68	Same wires as Test No. 2*a*. Each wire rotated through 180°
A	3	49.3	60	9.11	New set of wires.

TABLE 4

Test data: Activity of Wire Helices

Lubricant	*Test No.*	*Mean count-rate-meter reading, c/sec*
D	4	93.9
A	5	92.0

In further tests with wire helices each comprising 6 ft of wire separated from the G-M tube by a 5×10^{-4}-in. thick polystyrene sheath, typical results were obtained as given in Table 4.

Despite the large variations in activity between individual wires, the results given in Tables 3 and 4 suggest that the squirrel-cage configuration did not yield the maximum counting rate from a given amount of wear debris, possibly due to the different geometrical arrangement and shielding by the Perspex wall (0.04 in.) between wires and counter.

The use of wires wound in helix form appeared to be the most promising method and was adopted for further tests. In the standardized procedure, each wire was wound into a close helix of 26 turns. Thus, by locating the coil at a predetermined position along the axis of the G-M tube, a closely controlled geometrical arrangement was achieved. To minimize the risk of contaminating the counter with active material from the wire, a thin polystyrene sheath (10^{-3} in.), which was renewed for each wire assayed, was placed between the helix and the G-M tube. An annular paper disk was similarly used between the helix and the axial locator. The arrangement, with its lead castle, is shown in Fig. 3, and was used in conjunction with a scaling unit.

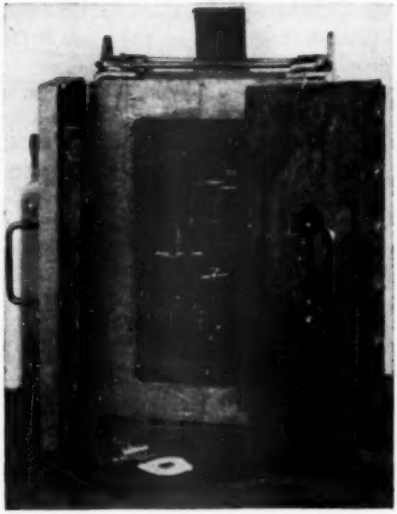

FIG. 3. Arrangement for assay of helices

TABLE 5

Test data: Effect on Counting Rate with Helix Reversed on G-M Tube (Test Series II)

Wire No.	*Initial activity, c/sec*	*Activity after reversal, c/sec*	*Difference, per cent initial activity*
1	100.33	111.56	+11.2
8	17.23	17.11	− 0.7
13	35.61	37.24	+ 4.6
50	75.29	85.35	+13.4
53	99.43	111.85	+12.5
62	70.34	69.18	− 1.6

As a check on any variation in counting rate when the position of the helix was altered relative to the G-M tube, certain helices were reversed and re-assayed. Typical results are presented in Table 5. It is possible that the variations shown may be due to the occurrence of a very active particle or group of particles at one end of the helix, causing an appreciable difference between the radiation scattered into the counter according to whether this end is adjacent to or remote from the iron axial locator. The differences between counts when helices were replaced without reversal were considerably smaller.

A number of helices were unwound and then rewound and re-assayed to

investigate how tenaciously the wear debris was retained on the wires. The results are presented in Table 6.

In some cases a marked decrease in counting rate occurred after rewinding, but it was generally considerably less than the variations between wires reported later in the section on *Results of Wear Tests*. There are two probable reasons for such a decrease: (1) In rewinding, 2 of the original 26 turns of the helix had to be discarded, and it is possible that, due to the erratic disposition of the wear particles, a large deposit was taken away with the turns removed. (2) The uncoiling and rewinding process was more drastic than the careful original winding, and it is also possible that it completes the removal of wear particles which were merely loosened in the original winding.

TABLE 6

Test data: Effect on Counting Rate of Rewinding Helices (Test Series II)

Wire No.	*Initial activity, c/sec*	*Activity after rewinding,* c/sec*	*Difference, per cent initial activity*
70	42.10	38.2	− 9.3
92	63.30	56.6	−10.6
105	74.57	56.3	−24.5
120	39.15	37.6	− 3.9
145	185.30	129.8	−30.0
164	74.86	29.2	−61.0

* Corrected for turns ratio and decay since initial count.

Design of Experiment

Because of the erratic occurrence of wear debris, it was clear that, in the wear tests, as many wires as possible should be drawn. This number was limited by the half-life of the W^{187} isotope, and the rate at which wires could be drawn and assayed. In practice, wires could be drawn faster than they could be assayed.

The count for each wire was converted to the value it would have had at the time of assaying the first drawn wire, assuming a 24-hr half-life. This assumption was justified by the decay curves of a few representative wires.

Other decisions had to be made before the design of the experiments could be finalized. One was whether to study drawing speed as a variable; in view of the complication of subdividing each length of wire, etc., it was decided instead to concentrate on differences between lubricants irrespective of drawing speed. The second decision to be made was how best to clear away one lubricant in preparation for tests with another; this appeared to be by washing out and then removing the last traces of the previous lubricant by actually drawing wires using the new lubricant. The first few wires so drawn were incompletely representative of the new lubricant, but by randomizing the order of using the lubricants, their inclusion in the tests seemed not to invalidate the results.

In the scheme adopted, each of three lubricants believed to have widely different performances as regards industrial die life was used repeatedly in random order, five wires being drawn on each occasion.

Results of Wear Tests

In the first series of tests, a total of 95 wires were drawn and assayed. The results of these tests were inconclusive and a second series of 180 wires was completed in a similar manner after reirradiation of the die.

The total number of disintegrations recorded for individual wires ranged from approximately 83,000 for the very active wires drawn early in a series, to 4,000 for the lower activity wires drawn at a later time; the corresponding standard deviations of counts thus ranged from approximately 0.4% to 1.6%.

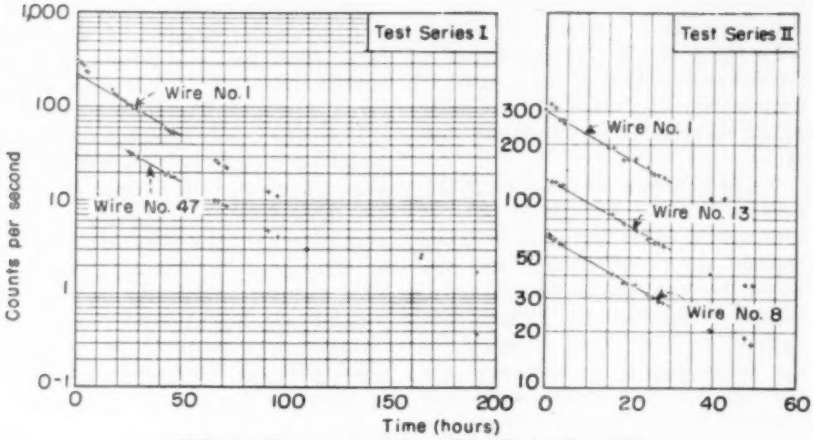

FIG. 4. Decay curves from Test Series I and II

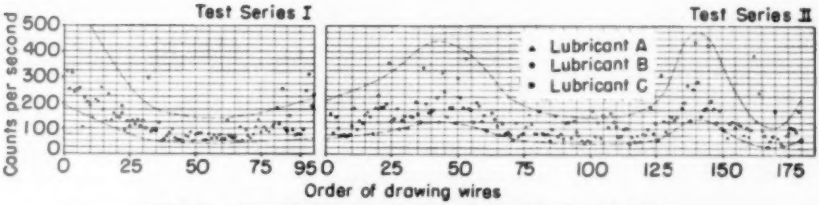

FIG. 5. Graphical presentation of results of wear tests

In general, the decay curves were as expected from the known radioactive constituents of the die material. The curves for a few representative wires are shown in Fig. 4, in which lines with a slope equivalent to a 24-hr half-life are drawn through the experimental points, over the period of the wire drawing tests. The close fit over this period justifies the assumption of 24-hr half-life in the decay corrections.

The early portion of the decay curve of the first wire in the first series exhibited a rather steeper slope than anticipated. This could be accounted for by the presence of an isotope with a half-life less than the 24-hr W^{187}, and suggests the possibility of the existence of a film of radioactive copper Cu^{64} (half-life 12.8 hrs) in the bore of the die. Such an isotope could have arisen from copper left from wires which had been drawn prior to irradiation, and it may be that this active film was removed when drawing the first few wires through the activated die, being gradually replaced by nonactive copper. An attempt to confirm the presence of such a copper isotope proved unsuccessful.

The results of the two series of tests are shown in Fig. 5 in which the ordinates represent the activities of individual wires in c/sec, corrected for deadtime, background, and decay, and the abscissas represent the order of drawing wires.

The wear appears to vary with order of drawing, as is emphasized in the graph by the envelopes enclosing the points; the lower is reasonably well

defined, and the upper is a replica of it with ordinates multiplied by an arbitrary factor of 3.5. The envelopes so derived enclose 92% of the points and demonstrate that the latter are more widely scattered at high activities than at low.

It may be that there is a possible link between the first and second series of tests, as the sequential wear variation appears to follow through the two series; the envelopes as drawn are continuous in this respect. It should be realized, however, that although the two series were performed with the same die, it is unlikely that the nuclear reactor factors were exactly equal for the two irradiations. Also, the activity of the cobalt constituent in the second series should be approximately double that of the first series, because the time elapsing between the two irradiations was small compared with the half-life of cobalt.

By assuming that the general level of the wear rate from Fig. 5 gives an activity of 150 c/sec, a rough estimate may be made of the rate of removal of material from the die. The assumptions that the helix arrangement gives a geometrical factor of $\frac{1}{3}$, and that beta particles from W^{187} only are recorded, lead to an estimate of about 3×10^{-8} gm of die debris per foot of wire, which confirms previous estimates.

A wide range of variation exists between the activities of individual wires. It is probable that wires of high activity are those having a comparatively large number of tungsten particles or particles of abnormal size in the wear debris. Wires of low activity might be those having fewer tungsten particles in the wear debris, a greater proportion of the activity in the latter case being due to cobalt.

An analysis of variance for each series indicated that there was no discrimination between lubricants in these tests, one possible explanation being that any such differences are obscured by the sequential variation of the wear rate. Statistical refinements to separate the effect of the latter are under consideration.

In the two series discussed, the total length of wire drawn (about 1,600 ft), although nearing the upper limit on our laboratory scale, represents only about one minute of production on a high-speed industrial drawbench. This, therefore, raises the question of whether a uniform die-wear rate may be expected within such a period which represents so small a fraction of the useful life of the die.

Discussion

The radioactive technique as applied to the problem of die wear has adequate sensitivity to detect the small amount of wear debris involved, and its use in this work is notable in that it is the first known occasion when the minute wear deposits from a tungsten carbide die have actually been detected on the drawn wire. Apart from any other considerations, the erratic distribution of the wear products revealed in this way makes it difficult, or perhaps impossible, to predict die wear in industry from laboratory tests such as described.

The usefulness of such tests seems rather to lie in the investigation of the fundamental processes of die wear, and they provide some information on the nature of the wear mechanism, which previously has only been conjectured.

The fairly uniform background of wear deposits appears to be chiefly cobalt eroded from the die by the polishing action of the wire and is probably from regions (b) and (c) of the die (see Fig. 6). The erratically distributed particles superimposed on this background may be of tungsten carbide plucked out of the die, and these will have come almost entirely from the "ring" region (a), since heavy wear occurs there in practice.

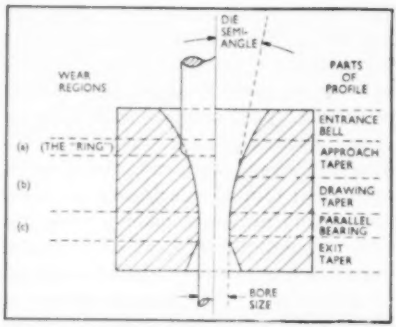

FIG. 6. Cross section of typical tungsten carbide insert for a wire-drawing die

The groups of uniformly spaced particles, which occur occasionally, suggest a stick-slip mechanism, possibly coincident with the natural frequency of some part of the apparatus; their occurrence is unrelated to drawing speed.

The counting experiments show clear evidence of a sequential variation in the rate of wear. The effects of lubricants are thus made more difficult to distinguish. This, together with the extremely short total length of wire drawn, may account for the apparent lack of differentiation between the lubricants in the present tests.

* * *

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*Design of Directional Counters for Clinical Use**

Collimated counters are useful tools in medical research with gamma-emitting radioisotopes. Design factors are discussed with particular reference to a small G-M counter for clinical use with radioiodine

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EVER SINCE the early days of medical work with radioisotopes it has been evident that collimated counters may provide valuable data on the spatial distribution of tracer elements in the body. The isotope of principal interest in this connection is I^{131} which has been used for studying the distribution of functioning thyroid tissue (*1–8*) and for the localization of brain tumors (*9, 10*).

A directional counter may be used as a rapid search instrument simply by moving it over the body surface; alternatively an area may be systematically scanned so as to yield an isotope distribution diagram which may take the form of a set of interpolated "isocount" contours. The use of such diagrams or

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† Work undertaken on behalf of the Medical Research Council.

Directional Counter Requirements

Clinical experience with ^{131}I suggests that a directional counter should have . . .

1. High sensitivity
2. A polar diagram free of subsidiary lobes
3. A thick side wall to reduce interference from strong sources on the fringes of the field
4. A sensitive solid angle constant in size within the field depth
5. Provision for adjusting this solid angle to suit the mean concentration of isotope within the field
6. Small size and weight

maps for estimating the volume of functioning tissue has been described (*5*, *7*) and Mayneord has demonstrated the possibility of producing cathode-ray-tube pictures of isotope distribution by using an automatic scanning device (*11*).

This paper is mainly concerned with the design of a small directional G-M counter for clinical work with I^{131}. Many of the principles involved are applicable to the case of a scintillation instrument, and mention will be made of the modifications which would be desirable for directional detection of hard-gamma-ray emitters such as Na^{24}.

To be directional, the counter must have a sensitive solid angle that is constant in size within the field depth. The achievement of this makes the counter response to a large distributed source independent of the distance of the source. This feature may be valuable in the interpretation of an isocount map when the concentrations of isotope depart markedly from the condition of point sources.

Choice of G-M Tube

The possibility of using a gamma counter with inherent directional properties will first be briefly mentioned. The beaded-anode type of tube invented by Stever (*12*) can be rendered directional for gamma rays by using a suitably disposed beta radiator and an electronic pulse-height discriminator (*13*). Rajewsky has described the directional properties of bi-metal cathodes (*14*), and a coincidence arrangement operating on secondary betas has been suggested (*13*). However, the degree of directional resolution that can be achieved by these methods is not large, and they entail geometrical arrangements inconsistent with requirements for high sensitivity and small size.

The response of a G-M tube which is fully exposed to a gamma-ray beam of given quality and intensity is a function of the material and effective surface area of the cathode; it is rather insensitive to the orientation of the tube with respect to the direction of the beam (*15*). These considerations suggest the use of a small G-M tube provided with a cylindrical cathode and enclosed within a collimating shield of tubular form; for soft gammas a lead cathode will provide high sensitivity. The design of the collimator under these conditions must take into account the fact that the gamma-sensitive region of the counter is a thin layer on the inner surface of the cathode cylinder.

Possible faults. The basic set-up is shown in Fig. 1. We will consider a point source moving over a plane, *PQ*, normal to the counter axis, since this defines the conditions under which results can be considered interpretable.

A collimated G-M tube is shown diagrammatically in Fig. 2. When the iris, *I*, and plug, *J*, are removed, a response curve such as curve *A* in Fig. 1 is normally obtained. Now we can decrease the aperture until it is less than the effective cathode diameter by inserting an iris, *I*. This will sharpen the response characteristic as shown by curve *B* in Fig. 1 without necessarily causing any diminution in the counting

rate for a point source at $\theta = 0$. However, if the distance s_1 becomes too great, the iris will throw a shadow on the forward edge of the cathode as shown in Fig. 2; this causes a flattening of the response characteristic which may degenerate into a double hump as shown by curve C in Fig. 1.

Assuming that this critical value of s_1 has not been exceeded, we may now further increase the sharpness of the response by inserting a plug, J, into the iris. Again there is no diminution in the peak response to a point source until cathode-shadowing occurs. In this case the shadow thrown by the plug appears at the rear edge of the cathode when the source is moved too close, and a response curve such as curve C in Fig. 1 may again result. This plug-shadow effect may be utilized to render the counter relatively insensitive to the distance of an axially-placed point source (*5*). Such a procedure, however, does not seem advantageous for our main purpose since it contravenes requirements of high sensitivity and sensitive solid angle constant within the field depth, and may introduce the double-hump effect at short ranges.

It is evident that the geometrical conditions depicted in Fig. 2 set a limit to the directional resolution that can be obtained with full cathode utilization over a given depth of field. In practice, however, this limit is less restricting than that set by the sensitivity of the G-M tube to the weak sources normally encountered. Where these considerations do not apply, a very small aperture can be employed without double-hump effects at the more distant ranges by tilting the G-M cathode with respect to the collimator axis (*8, 11*); this procedure, however, leads to a rather awkward geometry and makes difficult the achievement of reasonably full cathode utilization combined with an axially symmetrical response characteristic.

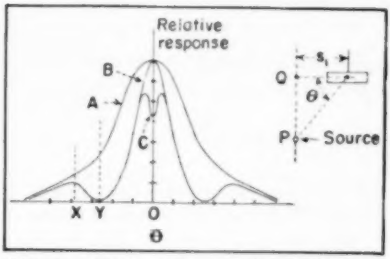


FIG. 1. Basic set-up and possible response characteristics for a counter

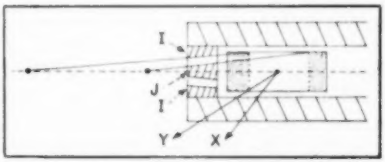


FIG. 2. Diagrammatic representation of a collimated G-M tube

Another possible fault, which in this case is independent of the geometry of the detecting device, is the side-wall peak shown at X in Fig. 1. (The direction of X with respect to the counter axis is shown in Fig. 2.) Such peaks may be pronounced when the aperture is small, and they can be highly misleading. Although the effect of these peaks can be removed by subtracting the counts obtained during a secondary scanning with the aperture blocked (*7*), such a procedure is time consuming and the necessity for it should be avoided.

The complete response curve for a collimated counter may be considered in three phases: between $\theta = 0$ and Y (Fig. 1) the response is largely governed by geometrical considerations, provided the axial depth of absorber used in the collimator is suited to the hardness of the radiation; between Y and X the curve is determined by penetration and scatter in the muzzle region (scatter from the inner surfaces of the iris may make the principal contribution to the response when the side wall is thick and the aperture large); from X outwards

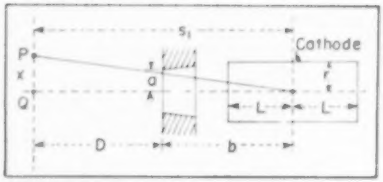


FIG. 3. Diagram to illustrate theory of axial response and half-value radius

the response is almost entirely governed by the side-wall thickness.

The axial response. We must first calculate the counter response to an axially placed point source of the relevant isotope. The efficiency of G-M tubes as gamma-ray detectors has been investigated by a number of writers (*15–21*). The efficiency is usually interpreted as the proportion of counts per photon that traverses the sensitive volume when the counter is broadside to the radiation. This conception of efficiency becomes misleading when considering a gamma counter used in an end-on position, and we therefore give in Table 1 some response coefficients defined as the number of counts per minute per unit area of cathode surface for one microcurie at unit distance. These figures are based partly on results with standard ethyl-formate-quenched tubes and partly on the data of Bradt *et al.* (*21*) as quoted by Curran and Craggs (*22*).

When the cathode cylinder is placed end-on to the gamma-ray beam, the figures in Table 1 must be multiplied by a factor which we shall designate as β, the end-on-to-broadside ratio for a parallel beam. This factor depends on the photon energy and the fine structure of the cathode; it has values which normally lie in the region 0.7–0.9.

There are two other points regarding the use of Table 1. First, a wire-mesh cathode may have an effective area substantially greater than that of a dimensionally similar foil cathode (*23*). Secondly, the sensitivity of the G-M tube may be considerably increased owing to penetration of its envelope and cathode by secondary beta particles ejected from the collimator wall. This effect is not noticed with I^{131} in the case of a lead-cathode tube having a 1-mm glass envelope, but it has been found to double or treble the sensitivity of an immersion counter used to detect the gamma rays from the same isotope.

Referring to Fig. 3, the condition for full exposure of the cathode to the rays from a point source at Q is seen to be

$$a \geq Dr/(s_1 - L) \qquad (1)$$

Under these conditions the response of the counter to the point source is

$$\text{cpm}/\mu\text{c} = 2\pi\beta N(\phi_2 - \phi_1)$$

and, when $(s_1 - L) \gg r$

$$\begin{aligned}\text{cpm}/\mu\text{c} &= \beta AN/(s_1 - L)(s_1 + L) \\ &= \beta AN/s^2 \qquad (2)\end{aligned}$$

where β is the end-on-to-broadside ratio; N is the response coefficient (see Table 1); ϕ_1 and ϕ_2 are the angles of incidence in radians at opposite ends of the effective cathode; s_1 is the range to the center of the cathode; s is the geometric mean of the extreme ranges; and A, $2L$, and r are, respectively, the effective cathode's area, length, and radius.

Half-value radius. We next require a measure of the directional resolution of the collimated counter. The quantity which we shall use for this purpose is the half-value radius, $x_{\frac{1}{2}}$, defined as the radial displacement of a point source required to reduce the counting rate to one half of its peak value. This quantity is convenient in practice because, first, it can be easily measured, not being appreciably affected by the finite size of a test source provided this is reasonably small, and secondly, because it enables the response of the counter to a distributed source to be estimated easily without precise reference to response-characteristic shape.

Referring again to Fig. 3 we will con-

sider the case of a simple collimator, that is, an iris without a plug. The iris is assumed to be tapered, if necessary, so that its effective radius, a, is at a distance D from the source plane. Approaching the problem as though it were a purely optical one, involving simple solid geometry, we obtain the following expression for the value of x at which the iris shadow approximately bisects the cathode cylinder

$$x = \sqrt{(sa)^2 - (Dr)^2}/(s - D) \quad (3)$$

This expression is found to give values of $x_{1/2}$ which are in good agreement with observed results provided $Dr \ll sa$, where s is the geometric mean of the ranges at opposite ends of the cathode; in other conditions the formula gives an underestimate. If we now drop the D^2r^2 term from Eq. 3 we get

$$x_{1/2} = sa/(s - D) \quad (4)$$

or, when $s \gg L$

$$x_{1/2} \approx s_1 a/b \quad (5)$$

where b is the distance from the iris to the cathode center. The above relations were tested with several types of G-M tubes, using the following range of values for the parameters: a = 0.3–1.0 cm, b = 5–14 cm, and D = 2.5–25 cm. In most cases, Eq. 4 gave values of $x_{1/2}$ very close to those observed; the only apparent errors occurred at large values of D and were probably due to inaccuracies of alignment. It would appear, therefore, that Eqs. 4 and 5 are useful in first stages of collimator design.

Distributed sources. The sources encountered in clinical work are normally of such a size that consideration of counter performance in terms of point sources is misleading. The mean concentration of isotope within the field will correspond to a certain mean value of counting rate during the scanning process. This mean rate must be sufficiently high so that significant variations of concentration within the field may be detected within a reasonable time. We will, therefore, consider the response of a collimated counter to a 1-μc/cm^2 semi-infinite plane source normal to the counter axis.

TABLE 1
Response Coefficients for γ-Emitters (Cathode Cylinder Broadside to Radiation)

	cpm/μc	
Isotope	*Cu cathode*	*Pb cathode*
I^{131}	150	850
Au^{198}	160	770
Fe^{59}	660	970
I^{130}	850	2,400
Co^{60}	1,400	2,000
Na^{24}	2,200	3,000

Simplified forms of the response characteristics obtained in practice are shown in Fig. 4A. When the characteristic has a flat top of width $2x_1$ we obtain the following expression for the effective area of the semi-infinite source

$$\frac{\pi}{3}\left[(x_{1/2} - x_1)^2 + 3x_{1/2}^2\right] \quad (6)$$

When $x_1 = x_{1/2}$ this becomes $\pi x_{1/2}^2$, but as x_1 is reduced towards zero the value approaches a maximum of $(4/3)\pi x_{1/2}^2$. In the absence of the curved tail at the foot of an actual response characteristic, the effective area would lie somewhere between these limits; when the tail is taken into account it is found that the true effective area does not normally differ greatly from the theoretical maximum.

We therefore obtain the following estimate of the counter response to a semi-infinite plane source

$$\text{cpm}/\mu\text{c}/\text{cm}^2 = \frac{4}{3}\pi\beta AN\left(\frac{x_{1/2}}{s}\right)^3 \quad (7)$$

or, using the approximation of Eq. 5

$$\text{cpm}/\mu\text{c}/\text{cm}^2 \approx \frac{4}{3}\pi\beta AN\left(\frac{a}{b}\right)^3 \quad (8)$$

Equation 8 shows that the distributed-

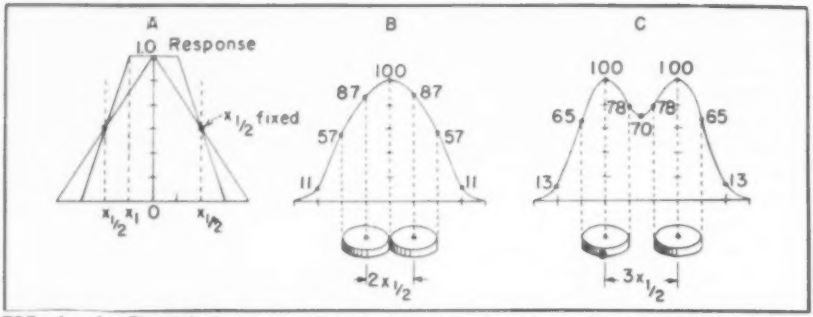


FIG. 4. A: Simplified response characteristics. B and C: Data showing resolving power for disks whose radii are equal to the half-value radius

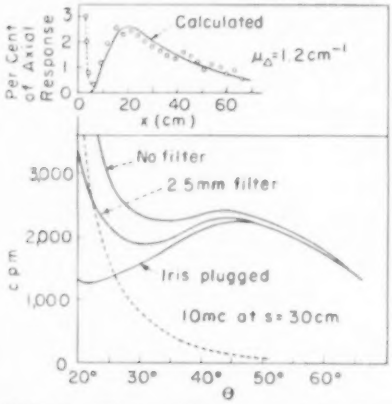


FIG. 5. Side response curves for two collimated counters showing side-wall peaks. I^{131} sources used for both sets of curves. A, top; B, bottom

source response is roughly independent of range, and hence this quantity is very convenient for determining the mean source intensity required, given a/b, or the maximum usable degree of collimation with a given source.

The extent to which Eq. 8 is valid in practice is shown by the data in Table 2 which were obtained with the counter shown in Fig. 9 used in conjunction with a large parallel-sided vessel containing a known solution of I^{131}.

It will next be useful to consider the counter response to finite sources of a size comparable with the half-value radius. Assuming the unfavorable case of a triangular response characteristic, it is found that a sphere whose radius is $x_{1/2}$ will give a peak response of about 71% of that for a point source of equal strength; the corresponding figure for a disk of the same radius is 67%.

The resolving power of the counter for two disks of this size is indicated in Fig. 4B and C; again we have assumed a characteristic of triangular form. When the separation between centers is twice the half-value radius the two disks cannot be resolved; the same is true of point sources at this spacing. When the separation is increased to $3x_{1/2}$, resolution becomes possible provided sufficient sensitivity is available. We may take this amount of separation as a reasonable index of the counter resolving power for compact sources.

Side-wall peaks. Two examples of the side-wall peak phenomenon are illustrated in Fig. 5; both sets of curves were obtained with I^{131} sources and lead cathode tubes. Figure 5A shows the very pronounced type of peak that may be obtained with a rather thick side wall (18 mm)* and a high degree of collimation. The response is shown as a percentage of the axial response for a small source, and is plotted as a func-

* All data refer to side walls of lead. It may be noted, however, that certain tungsten alloys have higher density and superior mechanical properties but require special machining.

tion of x, the distance from P to Q. In the case of a large source such as a thyroid gland, the relative size of the side-wall peak would be many times greater because the counter would "see" only a fraction of such a source when directed towards its center.

The curves in Fig. 5B were obtained with a counter having a 10-mm wall and a rather wide angle of view. Under normal conditions the side-wall peak is only just perceptible, but it becomes prominent when the aperture is stopped down. The dotted curve is the difference between the curve for no filter and the curve for the iris plugged; it represents the response due partly to scatter and partly to wall penetration in the muzzle region.

Referring now to Fig. 6, we will consider a ray from the source, P, penetrating a tubular side wall having an inner radius R and thickness t. Owing to the difference that normally exists between R and the effective cathode radius, we can treat the side wall as though it were flat, provided we employ a value of absorption coefficient which suits the geometrical conditions. Furthermore, we will start by considering the case where s is very large so that all the rays reaching the cathode arrive at substantially the same angle.

With these conditions we obtain the following expression for the side response in terms of the axial response for a point source

$$\text{relative response} = ks^2 \frac{\exp(-\mu_\Delta t \operatorname{cosec} \theta)}{s^2 + x^2} \qquad (9)$$

where μ_Δ is the differential absorption coefficient per cm of side-wall thickness, and k is a constant which takes into account the end-on-to-broadside ratio and the non-equality between μ_Δ and the linear absorption coefficient that determines the over-all side-wall transmission. This nonequality cannot be ignored in the case of polychromatic

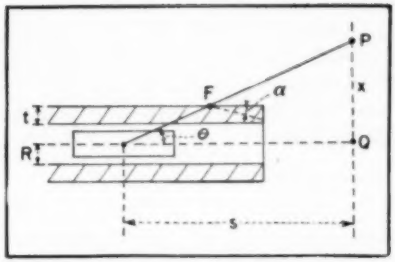


FIG. 6. Diagram to illustrate theory of side-wall peaks

TABLE 2
Response of the "Five-Pounder" to a Distributed Source

D*	$cpm/\mu c/cm^2$	
	$a = 6.5$ mm	$a = 3.8$ mm
0	625	170
2.5	611	156
5	578	145
10	569	141
Calculated	579	146

* The distance in cm from the counter muzzle to the face of the vessel, which had an area of about 220 cm^2.

radiation. The value of μ_Δ can readily be estimated by measuring the counter response for rays penetrating the side wall with and without a few mm of lead wrapped around the barrel.

Equation 9 can be written in the form

$$\text{relative response} = ke^{f(\theta)}$$

where $f(\theta) = 2 \ln \cos \theta - \mu_\Delta t \operatorname{cosec} \theta$. Now $df(\theta)/d\theta = \mu_\Delta t \operatorname{cosec} \theta \cot \theta - 2 \tan \theta$, and equating $df(\theta)/d\theta$ to zero we obtain the following equation in θ_m, the angle at which the response reaches a maximum,

$$\mu_\Delta t = 2 \sin \theta_m \tan^2 \theta_m \qquad (10)$$

Equation 10 can be solved graphically by means of Fig. 7 which shows that the most useful values of $\mu_\Delta t$ will produce side-wall peaks at values of θ between

about 40° and 60°. Theoretically the system should operate as a gamma-ray spectrometer but the resolution is poor.

Having determined θ_m we may use the following expressions to evaluate the amplitude of the side-wall peaks

$$\text{relative response at } \theta_m = k \cos^2\theta_m \exp(-2\tan^2\theta_m) \quad (11)$$

$$\text{cpm}/\mu\text{c at } \theta_m = AN \cos^2\theta_m \times [\exp(-\mu t \operatorname{cosec}\theta_m)]/s^2 \quad (12)$$

Equation 11, uncorrected by the factor k, is plotted against θ_m in Fig. 7. Equation 12 defines the side-wall peak in terms of μ, the over-all absorption coefficient per cm of side-wall thickness.

The calculated curve in Fig. 5A was based on the assumption of a point counter; that is, the nonparallelism of the rays due to the finite size of s was ignored. Numerical integration in this case showed that in general a more elaborate analysis is not justified since the effect is mainly to shift the inner edge of the peaking curve slightly towards the origin without much affecting the peak amplitude or that part of the curve corresponding to $\theta \geq \theta_m$. Using Fig. 7 and Eq. 12 the theoretical value of the peak in Fig. 5B was found to be 2,200 cpm at $\theta = 43°$, for $\mu_\Delta = 1.2\ \text{cm}^{-1}$.

Provided the side wall is reasonably thick in relation to the hardness of the radiation, the undesired peaks can be eliminated without a great loss in resolution by suitably shaping the muzzle. Assume that the ray in Fig. 6 has been drawn at the peaking angle from a point somewhat forward of the counter center, cutting the outer wall surface at F. We may now taper the wall from this point at an angle α such that $dy/d\theta = 0$, where y is the length of the transmission path through the side wall. The value of α is given by

$$\tan(\alpha + \theta_m) = [(t + R)/R] \tan\theta_m \quad (13)$$

Provided that R is not very small compared with t, it will be found that Eq. 13

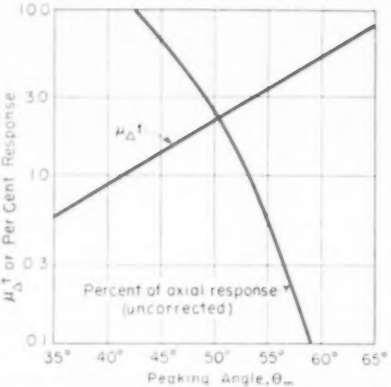


FIG. 7. Data for evaluating position and amplitude of side-wall peaks

defines the constant-y locus reasonably closely for all parts of the cathode.

Scatter effects. The fact that scatter from the aperture surfaces can have an important effect on the response characteristic in the XY zone (Fig. 1) has already been mentioned. The effect is greatly reduced by decreasing the iris diameter or by insertion of a plug.

G-M tubes with cathodes of high atomic number (lead, platinum, and bismuth) show, according to most of the authorities, a marked rise in efficiency at photon energies below about 0.5 Mev. It follows that when such tubes are used in the interest of high sensitivity, scatter effects are likely to be emphasized. Taking the data of Bradt *et al.* (*21*) it is found that the sensitivity of a lead-cathode tube to back-scattered radiation from I^{131} is about 1.4 times the sensitivity to the primary radiation.

Differential filtration may sometimes be useful, particularly with a view to improving directional resolution when a lead-cathode counter is used to explore a deep field of tissue. Figure 8 gives the relevant data for I^{131} and suggests that a lead filter 1.5–2 mm thick will give a useful amount of discrimination against backscatter. Such a filter

should be recessed as far behind the aperture as possible, it will then serve the additional function of reducing scatter effects from the aperture surfaces. Curve *B* in Fig. 8 was taken with the counter exposed to an effective volume of about 1.2 liters of tissue.

Table 1 shows that when the radiation is hard the gain in sensitivity obtained by using a high-atomic-number cathode is quite small. It follows that a directional counter for use with hard gammas should employ a cathode of low atomic number, e.g. aluminum, carbon,

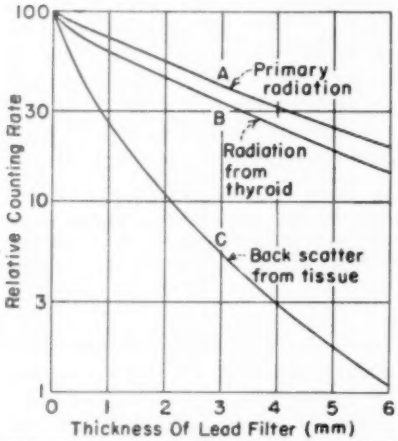


FIG. 8. Response of lead-cathode G-M tube to I^{131} gammas with various amounts of lead filtration

or iron. In these circumstances considerable discrimination against scattered rays is obtained without the need for filtration. Furthermore, since rays penetrating the side-wall contain a large scattered component, the relative side response will be materially reduced for a given side-wall thickness.

The "Five-Pounder"

Figure 9 is a sectional drawing of a counter designed for clinical work with I^{131} in accordance with the foregoing principles. The small G-M tube used has a cathode of lead foil supported in copper gauze; the effective area is about 12 cm². The glass envelope is comfortably accommodated in a half-inch bore-hole which serves as the aperture when the counter is used in its low-resolution condition.

In the drawing the counter is shown with all accessories in use, namely the medium-resolution iris nozzle and the high-resolution plug; the latter is located by means of plastic disks and can be separately withdrawn. Provision is made for the optional use of a 2-mm lead filter situated close to the tip of the G-M tube, when using any of the three degrees of resolution. The dimensions and angles of the nozzle and plug are chosen to give approximately full cathode utilization in the range D = 2.5–15 cm; no double humps are produced within this depth of field.

The rear compartment, with its removable cap, has a 5-mm lead wall; this is sufficient to reduce the counter response due to scatter from this region to a small fraction of that due to rays penetrating the 23.5-mm side wall. The cathode pin is connected to the frame by means of a socket carrying a spring-loaded plunger which also serves

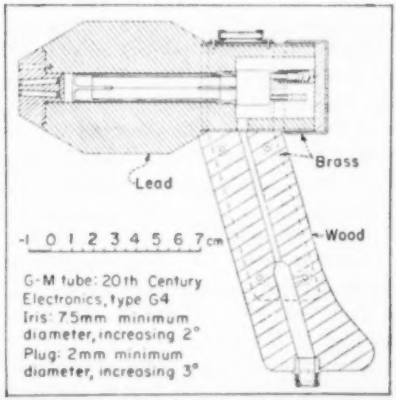
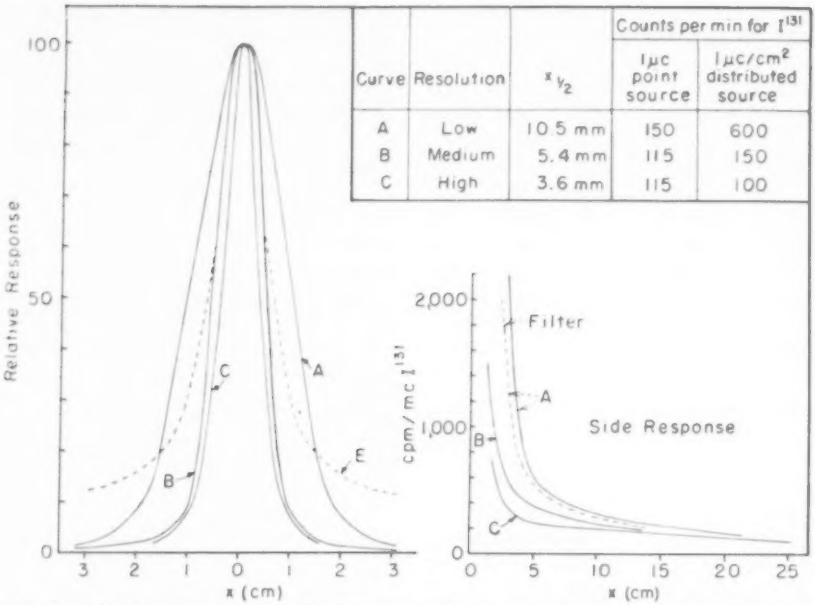

Brass
Lead
Wood
-1 0 1 2 3 4 5 6 7cm
G-M tube: 20th Century Electronics, type G4
Iris: 7.5mm minimum diameter, increasing 2°
Plug: 2mm minimum diameter, increasing 3°

FIG. 9. Sectional drawing of the "Five-Pounder," a directional counter for clinical work with I^{131}



Curve	Resolution	$x_{1/2}$	Counts per min for I^{131}	
			1μc point source	1μc/cm² distributed source
A	Low	10.5 mm	150	600
B	Medium	5.4 mm	115	150
C	High	3.6 mm	115	100

FIG. 10. Performance data for the "Five-Pounder." For all curves, the source plane was 2.5 cm from the muzzle. Curve E is the response to radium gammas, when medium resolution is used

to hold the G-M tube firmly in position. The anode pin is mated with a socket on the end of a flexible lead running to a coaxial cable brought up through the handle. Above the rear compartment a spirit level is fitted to aid in lining-up.

Figure 10 shows performance data for this counter with I^{131}; all the curves are drawn for a source-plane 2.5 cm from the muzzle. The observed values of $x_{1/2}$ (curves *A* and *B*) are in accordance with Eq. 4. Figures are given for the response to a 1-μc point source at $D = 2.5$ cm and for a 1-μc/cm² distributed source. The point-source response figures are inferred on the basis of full cathode utilization which is justified by the geometry; the difference between the figure for curve *A* and that for curves *B* and *C* is due to the fact that the detachable nozzle increases the range for a given source-to-muzzle distance. The side-response curves shown on the right enable the effect of a large and active source on the edge of the field to be conveniently estimated. It is seen that the counting rate drops smoothly as x increases under all conditions; at the same time the relative response at $x = 3$ cm is satisfactorily low with an iodine source.

Hard gammas. Curve *E* in Fig. 10 shows the "Five-Pounder's" response to radium gammas using medium resolution. The half-value radius is only 22% larger than that obtained with an iodine source under the same conditions, but the relative response at $x = 1.5$ cm, has risen seven fold. It is clear that for hard-gamma emitters a different design is required.

Copeland and Benjamin (*24*) have discussed a related problem in connection with the design of a gamma-ray

pinhole camera. Very penetrating radiation demands the use of collimating surfaces that are both axially extensive and parallel sided, and it is suggested that an efficient design might be based on the use of a needle-type G-M tube as described by Robinson (*25*). The tube would be deeply set in a bore hole through a block of absorber which would be of nearly spherical shape in the muzzle region. It might be advisable to surround the cathode with a layer of low-atomic-number material to reduce the "lead-cathode effect" of the absorber wall. A similar arrangement would be suitable for use with a scintillation counter. It is evident that the high sensitivity of the latter type of counter, together with the flexibility of its geometry, opens up interesting possibilities in directional gamma counting.

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*Some Industrial Applications of Radioelements Made at the Commissariat à L'Energie Atomique**

The French counterpart of the U.S. AEC is actively engaged in showing industry how radioactivity can solve some of its problems. Six specific problems, the methods of attack and results are discussed

By JULES GUERON

Department of Physical Chemistry, Commissariat à L'Energie Atomique Paris, France

IT IS COMMON for nuclear laboratories to be approached by persons or firms who believe that radioactivity will solve their problems by some sort of magic action. While no magic is involved, radioactivity has nevertheless been used

* Paper presented at the Radioisotopes Techniques Conference, Oxford, England, July 19, 1951.

to gain knowledge leading to solution of a wide circle of industrial problems. The Commissariat à L'Energie Atomique, in collaboration with other organizations, has applied radioactivity techniques to leak detection, measurement of air renewal in rooms, viscosity measurements, and the tracing of water through soil or rocks.

Leak Detection

Two problems of the telephone industry—detection of faulty repeaters for deep-sea cables, and maintenance of pressure in long-distance telephonic cables—have been solved. In addition, progress has been made in the detection of leaks in welded tanks.

Faulty repeaters. The Compagnie Industrielle des Téléphones wanted to reject faulty repeaters before they were installed in deep-sea cables. The electronic equipment of these repeaters is housed in steel shells looking roughly like truncated ellipsoids. The plane faces are joined to the ellipsoid body by welded self-tightening joints. These faces bear the leads, which are insulated from the steel by glass beads. The thickness of the steel shells varies from 8 to 15 mm.

These repeaters are placed at intervals of many kilometers in the cable. The entire assembly is enclosed in a polythene hose filled with liquid silicone. The pressure when the cable is immersed can reach 400 atmospheres. Any slow leak in the repeater shell would render the cable useless.

We tested these repeaters for leaks by immersing them in a radioactive sodium carbonate solution under 400 atmospheres in a pressure vessel. Coating the glass beads with a cellulose varnish completely prevented the exchange of sodium between the solution and the glass. The following procedure was used:

Sodium carbonate was irradiated in the reactor at Châtillon, France. A total activity of about 50 mc was obtained in 50 gm of Na_2CO_3. A solution was prepared in 4.5 l of water. One drop of this solution inside a repeater was clearly detectable when a Victoreen beta-gamma survey meter or a corresponding CEA instrument was used.

The repeaters to be tested were lightly but carefully varnished and dried. A preliminary pressure treatment with an inactive sodium carbonate solution filled up those minute cracks that could have taken up active solution but did not actually correspond to leaks. The repeaters were then placed in the pressure vessel, together with polythene beads that were added to reduce the free volume and thus allow as high a concentration of the sodium carbonate solution as possible. Pressure was applied and kept at 400 atmospheres for 5 hours. The repeaters were then taken out with long tongs and washed with inactive carbonate solution and water.

After the varnish had been removed with acetone, the repeaters were tested for activity. Only one showed activity, and some solution was found inside it. The satisfactory ones have been used in a cable which, to our knowledge, is working satisfactorily. This cable will be used between France and North Africa; it is now undergoing tests near the French shore.

Pressure maintenance in long-distance telephonic cables. A number of long-distance telephonic cables in France contain paper-insulated wires in a jute-covered lead envelope under 0.8 atmospheres of nitrogen. These cables are usually buried about 0.80 meters below the surface of the ground.

Any hole in the lead envelope can be disastrous if not detected and repaired before water has had time to leak into the cable. Small holes are generally detected by pressure measurements, and can be located within 30 to 40 meters by pressure-drop diagrams.

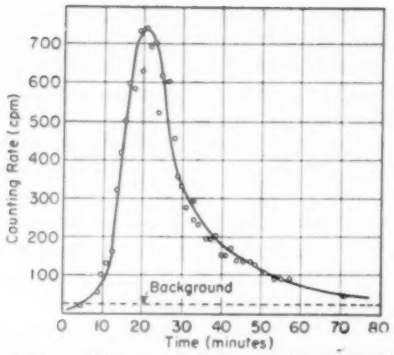

FIG. 1. Xenon activity as a function of time above 0.3 l/min leak under 35 cm of dampened loosely packed sand

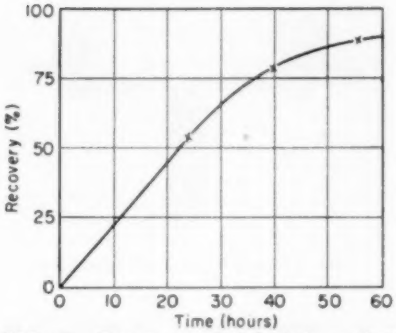

FIG. 2. Recovery of injected methyl bromide. Leak of 0.4 l/min at end of 230 meters of standard cable under 1 kg driving pressure

However, the manufacturers felt that in many cases it would be worth-while to try to improve the leak-detection procedure by using radioactive tracers. Accordingly, the Commissariat carried out a series of experiments with the Société Alsacienne de Constructions Mécaniques (especially Mr. A. Pagès).

With the tracer technique, it has been possible to locate leaks almost exactly. Success was conditioned, however, by the proper choice of radioactive product. The choice was governed by:

1. The product chosen must have a half-life long enough for the detection operations to be carried out, without requiring too long an irradiation.

2. Either beta or gamma radiation is usable, but it must be of at least moderate energy so that sturdy portable detection instruments can be used. This rules out use of C^{14}, recently proposed in similar cases (*1*).

3. The product should be a gas or vapor that is easy to prepare and use, and that does not cling to the cable components too strongly.

4. But the product should diffuse quickly enough through the soil while remaining in the surface layers long enough to permit easy detection.

Xenon containing the 5.4-day isotope produced in fission meets the first three requirements, but, as shown in Fig. 1, it diffuses out of the soil too quickly and might be missed altogether.

Bromine organic compounds were tried. Ethyl bromide is too strongly absorbed by the cable components, and too easily condensed.

Methyl bromide proved most suitable (*2*). It is easily prepared by reacting methyl sulfate on irradiated KBr (*3*). As shown in Fig. 2, it is not too strongly absorbed on cable components.

Many experiments have shown that the radioactive spot on top of the leak can be easily detected for a few days. Apparently diffusion upwards from the leak and radioactive decay compensate each other in such a way that the intensity of the radioactive spot remains fairly constant for about two days. Tests have been carried out over a period of a year, under widely varying weather conditions (extreme heat, severe frost or drenching rain). In all cases the radioactive spot has been found directly above the leak within the width of a spade.

The procedure is as follows: Methyl bromide (about 2.5 gm, or 600 ml at normal pressure and temperature, containing 10 mc of Br^{82}) is collected in the brass container shown in Fig. 3. This 400-ml vessel is fitted with bellows valves

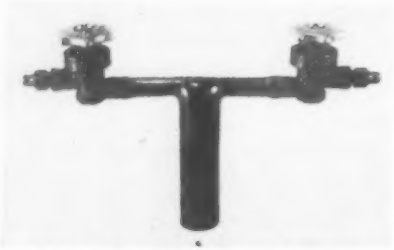

FIG. 3. Methyl bromide container

and standard nipples for assembly on the preparation as well as on the injection apparatus. In transport the nipples are covered by gas-tight lids, and the vessel is enclosed in a lead shield so that the radiation level on the outside of the shield is smaller than the tolerance dose.

In a typical situation, manometric devices indicate the location of the leak between two points 1,840 meters apart. The one nearest to the leak is actuated first and injection of the active gas is made at that point, using nitrogen at about 1 kg/cm² as a pusher; about 151 of nitrogen are used. Nitrogen pressure (1 kg/gm², while the normal maintenance pressure is about 0.7 kg/cm²) is maintained from the first valve further away from the leak (that is, about 460 m from the injection point) to avoid back diffusion of the radioactive mixture, and to speed up its movement towards the leak.

The leak is reached and the radioactive spot develops on top of it in a matter of hours, according to distance and leak output. We usually inject in the evening and survey the faulty section on the next morning. Using 10 mc of Br^{82} we have found that leaks of 0.08 to 0.2 l/min (which are considered quite small by the telephone people) give a radioactive spot such that the detecting-instrument indication is 10 times the background. This cannot be missed by a man walking at a brisk pace along the line.

Smaller leaks (estimated at about 0.01 l/min) have been successfully detected with a slightly more elaborate technique: nitrogen pressure is kept on both sides of the leak so as to give the active gas no chance of bypassing the leak altogether.

We are now considering leak detection in underground cables of other description which will probably need a more elaborate procedure than the simple one described above.

Leaks in welded tanks. Leak detection has been attempted with tanks whose outside surface can be inspected. Welded seams are, of course, the first regions to consider.

We attempted to inject a radioactive gas into the tank, collecting it in a solvent so as to increase the sensitivity of the method. Using methyl bromide again, we tried many collectors (kieselguhr or charcoal soaked in various nonvolatile solvents, greased tape). The best results were obtained with cellulose sticking tape. This was stuck on the suspect weld, left in place for a while, taken off, and examined with a counter. Active spots on the tape could be easily related to the corresponding leaks on the weld.

While such experiments may be useful in certain cases, they are as yet by far not satisfactory, because up to now, we have not exceeded, although we reached, the sensitivity obtained by the glycerine-soap water method. Obviously we could do better by using higher specific activities; these will be available when the second French pile provides a neutron flux more than 100 times as big as our present one. However, the over-all necessary activities may become somewhat cumbersome to handle in the case of large vessels. Other radioactive gases will have to be tried, because, using CH_3Br labeled with a mixture of Br^{80} and Br^{82}, we regularly found that the 18-minute activity of Br^{80} was the only one to appear on the

tape; what we observed, therefore, was not the expected dissolution of the tracer gas, but a radiosynthesis following the isomeric decay of 4.4-hr Br^{80}.

Air-Renewal Measurements

A method for measurement of air renewal in rooms was developed in cooperation with the Chambre Syndicale du Chauffage et de la Ventilation (*4*). The Chambre Syndicale was represented by Mr. Cadiergues.

For such measurement one should use a gas with a kinematic viscosity (viscosity × density) as similar as possible to that of air, so as to reduce errors due to bad mixing at the start, or to separation during the experiment. Radioactive nitrogen or oxygen being practically excluded, the best choice would be carbon monoxide, which is isosteric with nitrogen. Organic gases or vapors are not suitable. For convenience we made our first experiments with 5.4-day fission xenon (kinematic viscosity 45 $\times 10^{-3}$ cm^2 sec^{-1} against 150 $\times 10^{-3}$ for air).

This is obtained by dissolving pile irradiated UO_3 in nitric acid. The rare gases are carried out by bubbling hydrogen and trapped on charcoal in liquid nitrogen. Krypton decays rapidly, and the 5.4-day xenon is left to be desorbed by a stream of compressed air when it is to be used.

In one experiment, an unknown quantity of xenon was mixed with the air of a laboratory room by a fan that was set in action for five minutes, during which time it passed twice the volume of the room. After the fan was stopped, a perforated 10-liter ionization chamber, connected to an amplifier and recorder, was used to measure the activity. The record obtained is shown in Fig. 4; Fig. 5 shows a semilogarithmic translation of the smoothed curve. It is clear that the decrease of activity approximately follows a first-order law, as expected, and that the air in the room

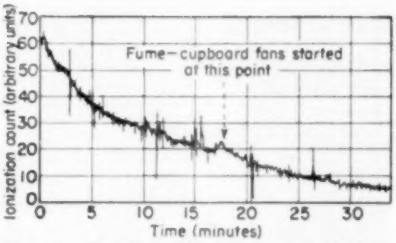

FIG. 4. Record obtained in a ventilation measurement using radioactive xenon

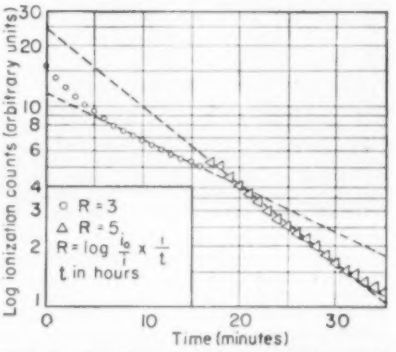

FIG. 5. Semilogarithmic plot of the smooth curve drawn from data of Fig. 4.

is changed three times an hour by natural ventilation (we chose a very leaky laboratory) and five times an hour when the hood fans are put in action.

We checked, in other cases, that the renewal rates did not vary substantially when read from simultaneous records taken at floor, mid-height and ceiling.

Xenon is innocuous and the apparatus is not too cumbersome; therefore the method can be easily applied in practice. One hour is sufficient for a satisfactory measurement.

Radioactive Viscosimeter

With the cooperation of Dr. R. Arditti of the French State Tobacco and Matches Factories, the Commissariat has developed a falling ball viscosimeter that employs radioactivity to detect passage of the ball. Applica-

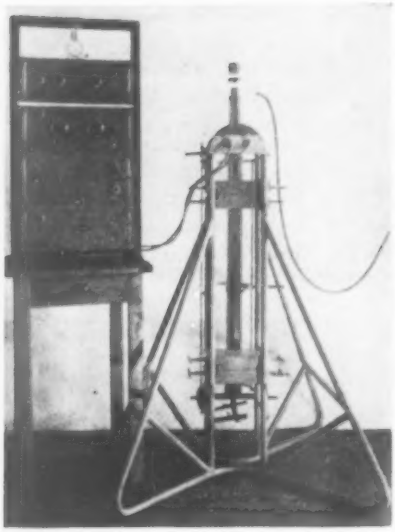

FIG. 6. Radioactive falling-ball viscosimeter. Counters have been removed to show lead defining slits in front of water-jacketed tube at right. From top to bottom at left are electric stopwatch, electronic equipment for flash and electronic stopwatch, scale-of-1,000, oscillator, and electronic switch

tion has been made for a French patent on this device. This instrument, shown in Fig. 6, is of interest for viscosity testing of opaque and very viscous liquids or pastes where the usual methods cannot be applied. In particular, electromagnetic detection of a metallic ball cannot be used when the falling speed is too low.

We use 4 to 8 mc of Co^{60}, either as a cobalt ball or as a diametral wire in a Lucite sphere (which may be convenient if a ball of small density is desired, or in corrosive liquids). Passage of the ball is recorded at two fixed levels, materialized by lead slits behind which can be placed halogen counters, small pressure ionization chambers, or any type of suitable detecting device. Slit width and integrating circuits can be so adjusted as to make roughly equal the time necessary for the ball to pass across the slits and the time constant of the circuit.

The activated counter (or ionization chamber) triggers a circuit which can (1) flash a bulb, on which indication an operator operates a stopwatch, (2) start or stop an electric stopwatch, and (3) start or stop a 10,000-cycle oscillator and an electronic switch by which the pulses from the oscillator are recorded on a scale of one thousand.

In its simplest form such an apparatus can be made quite cheaply, and it should be useful to laboratories or plants dealing with printing inks, dye pastes, match compositions, pitches, tars, etc.

Water Tracing

Preliminary experiments on the tracing of water through soil and rocks are being carried out by Mr. Gaestel. The major difficulty in such problems lies in the adsorption or ion-exchange phenomena in soils and rocks, which should be carefully studied in each particular case.

In the experiments underway, soil from a given spot in the French Southern Alps and water from a well-known stream are being used. These experiments are preliminary to a field test to be conducted in collaboration with the Solétanche Co., when we will have the opportunity of comparing fluorescein and radioactive tracers on relatively short paths of water.

Figure 7 shows typical results obtained by letting water flow through a column of soil 5 cm in diameter and 1 m high; that is, an apparent volume of about 2 liters. The free volume has been directly found to be of the order of 0.5 liters.

This was determined by the simple means of making a slurry with known amounts of soil and water, and pouring it in the experimental tube; the soil settles down rapidly. The water is then allowed to drain out until its surface reaches the top soil level. The volume so obtained, subtracted from

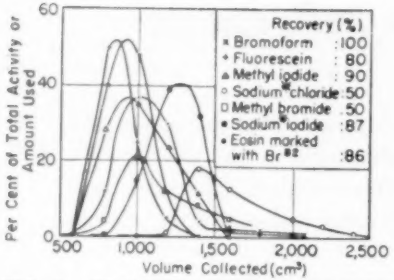

FIG. 7. Elution curves of various water tracers from a particular soil

the initial water volume, gives roughly the free volume of the column.

Activity (or concentration) expressed as per cent of the total tracer used is plotted against the volume of liquid collected at the bottom of the column. This is reckoned from the time at which the tracer has been added.

The following preliminary results have been obtained. While they illustrate a number of general features, they are applicable in detail only to the particular soil and water tested.

1. Fluorescein is not 100% recovered, but the recovery curve starts precisely after 600 ml of water have gone through the column, and the curve rises steeply; a slight tail confirms adsorption.

2. Ionic compounds such as sodium chloride and iodide are unsuitable. They are not completely recovered, the retention in the column being, as expected, greatest for the most dilute solutions. This retention is further demonstrated by the fact that the recovery curve has a very wide hump and sometimes a longish tail, and starts only after much more water has passed through the column than necessary to displace its original water content. In the case of sodium glycerophosphate labelled with P^{32}, a 1% solution containing about 1.5 μc per ml was prepared and 200 ml were used. All the activity was adsorbed on top of the column; elution was very slight, and we stopped the experiment after many liters of water had displaced a very small proportion of the activity less than 15 cm along the column.

3. Radioactivity provides such a sensitive detection method that experiments can easily be performed using water solutions of organic compounds, some of which are only very sparingly soluble in water. The recovery curves for cesium eosinate (labelled with Br^{82}), methyl bromide and methyl iodide show definitely that at least some adsorption occurs (late start, long tail, incomplete recovery; color and activity results are in agreement). While methyl iodide (solubility 1 gm/l; we used $\sim$2 μc of I^{131}) might be worth further study, bromoform (solubility about 3 gm/l) has proved most interesting. The elution curve starts at 600 ml, and it is quite symmetrical, in agreement with the 100% recovery. This, if confirmed in experiments using larger columns, should allow field applications with not unduly high amounts of tracer, even when one has to consider considerable dilution from underground side streams. We are now engaged in a careful examination of detection methods, as a preparation for full-scale experiments. Sensitivity may be increased either by using many counters disposed according to a pattern determined by the mean free path (not the range) in water of the radiation to be detected or by a physical or chemical concentration method.

* * *

Dr. H. Hering and Mr. P. Levêque have been actively associated with all the work described. The author would like to thank Mr. C. Fisher for preparation of a number of radioisotopes, especially the fission-product xenon.

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A New Automatic Radioassayer

A simple inexpensive sample changer for the radioassay of many similar samples has been developed. The device will restack the samples in order after counting. Circuitry for use with the unit has been developed and is also described

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COUNTING LARGE NUMBERS of similar samples requires the constant attention of a trained technician, unless automatic equipment for performing most of this tedious work is available. The equipment presently on the market is rather complicated and expensive, while the unit described here is simple and inexpensive to build and maintain.

The main principles applied in this new unit are vertical stacking of the samples and a short, straight line motion of the samples to the counting position. The unit is designed so that the counted samples travel out of the other side of the counting position to be restacked, rather than return to their original location. With this unit a stack of more than 20 sample holders has been counted and restacked.

The recording equipment includes a 1-ma Esterline-Angus recorder, an end-window G-M tube, a high-voltage regulated power supply, and a recording ratemeter. This integrating circuit was developed for use with this unit and has proved very stable under many conditions.

Changer Unit

Figure 1 shows the disassembled sample changer unit. The initial position of the samples is in the stack at the right, each sample having been placed in a Lucite sample holder. Samples as large as 1½ in. can be accommodated.

A continuously rotating driving wheel, shown below this stack of samples, is directly coupled to a constant speed motor. The actual changing of samples and operation of the counter may be considered as definite portions of a cycle, each revolution of the driving wheel being one cycle. No separate timing devices, sample positioners, limit switches, or relays have been used anywhere in the unit.

As the driving wheel rotates clockwise, the connecting rod is compressed within itself. This motion to the left is transmitted through a lever system to a small metal pusher. This pusher is the flat piece of metal that can be seen on the platform to the right of the sample stack. This pusher slides the bottom sample holder into the counting position. Approximately 90° of the wheel's rotation is required for shifting the sample.

As soon as the sample is in position, the microswitch shown immediately to the right of the wheel is released and counting begins. The microswitch is controlled by a cam on the rotating wheel.

Another 90° of the wheels rotation is required to return the pusher to its

original position. During this and the remaining 180°, the counter is operating. The connecting rod is built so that an internal spring disconnects the driving wheel from the pusher when the pusher is at the far right. The microswitch stops the counting during the shifting of the samples.

As the next cycle begins, the sample on the bottom of the stack at the right is pushed into position under the counter tube. The sample previously counted is pushed out the left by the next sample holder. Successive samples push each other through the shield to the holder at the left where the sample holders are restacked. Restacking consists of pushing the sample holders up under the previous ones. A small shaped weight is necessary in the restacking holder to keep the holders level.

The last sample holder is left under the counter tube, since no further sample holder is behind it to push it out. It is this feature which permits half-life or background measurements. If the last holder contains an active sample the instrument continuously records its decreasing activity and the half-life can be determined. If the last holder has no sample, the background will be recorded. Background can be checked during counting by alternately stacking loaded and empty sample holders. Absorption measurements can be made with only minor design changes.

The counter is a mica-end-window G-M tube mounted vertically in a 1-in. thick lead and brass shield shown in sections above the unit. An alpha scintillation counter could be added either before or after the beta-gamma position. A sample holder positioned for counting is evident just below the shield. The shield is removable for ease of tube change and maintenance.

The geometry of the counter is entirely reproducible for samples of any one size and depends only on the mechanics of the forward stroke. The sample holder is always left at precisely the same spot. The over-all counting efficiency has been determined using a RaD and RaE standard as approximately 25%.

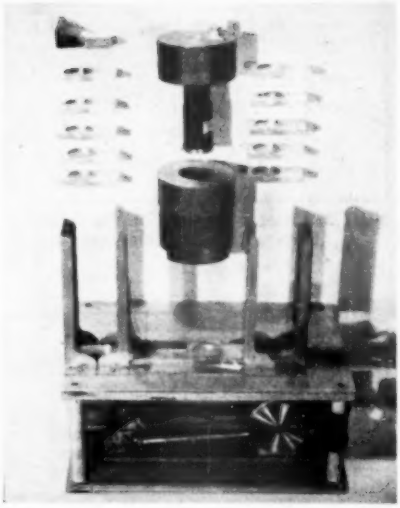


FIG. 1. The disassembled sample changer. Samples are moved from right to left. A Lucite sample holder is shown in the counting position

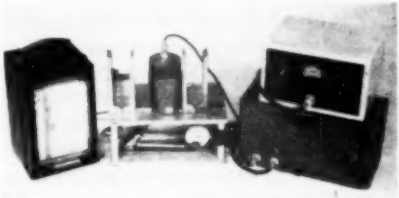


FIG. 2. The complete radioassay unit including ratemeter, power supply, recorder, and sample changer. The chart shows variations observed when the unit was used as a background monitor

Figure 2 shows the entire counting setup including the ratemeter, the power supply, the assembled sample changer, and the recorder. The stack of samples after counting can be seen at the left. The counter shield is in

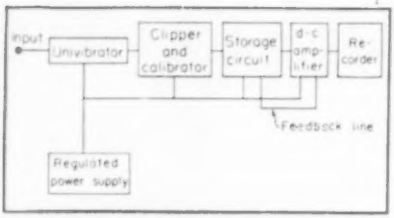


FIG. 3. Block diagram of the interconnection of circuit elements

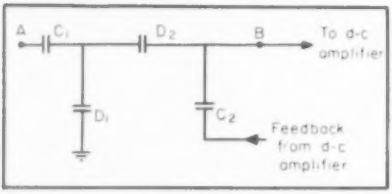


FIG. 4. The main element of the ratemeter, the storage circuit

place straddling the track in which the sample holders are moved.

The graph that shows on the recorder is a typical record made to check a possible outside influence on the background in one of the Health Physics counting areas. The recorder pen deflects to a point representing the total count during the counting period, and returns to zero during the change part of the cycle. Since the cycle timing is fixed the deflections give counting rates.

Circuitry

Figure 3 is a block diagram of the various elements of the circuit.

The main element of the ratemeter is the storage circuit shown in Fig. 4. Consider one negative voltage pulse of amplitude E volts impressed at point A in Fig. 4. Provided the pulse is long enough, the capacitor C_1 receives a charge of EC_1 coulombs through diode D_1. At the termination of the pulse, C_1 transfers practically all of its charge to capacitor C_2 since point B is at ground potential. This charge places on C_2 a voltage equal to EC_1/C_2. No provision is made to leak charge from C_2. A second pulse at point A causes an identical charge to be transferred to C_2 by C_1 provided point B is held at ground potential. Point B is held at ground potential by feedback from the d-c amplifier, regardless of the voltage across C_2. Thus, it is seen that each pulse builds up the voltage across C_2 by a definite amount. The charge or voltage on C_2 at any time is then proportional to the number of pulses that appeared at point A.

In the actual circuit the plate of diode D_1 is returned to +105 volts and point B is held fixed at approximately +105 volts by the feedback line instead of being held at ground. This is done to simplify the circuitry. However, the preceding discussion is valid except for this change in static potential.

Since for each pulse, capacitor C_1 must be charged through the forward resistance, R_{D_1}, of diode D_1, and through the impedance of the pulse source, R_0, the input pulse length to point A must be long compared to $(R_0 + R_{D_1})C_1$. The input pulse to point A is obtained from a univibrator. Since the output impedance of the univibrator, R_0, is much larger than the forward resistance, R_{D_1}, of the diode, a pulse length of at least $10R_0C_1$ is sufficient to charge capacitor C_1. The parameters of the univibrator are chosen to meet this requirement.

Another requirement on the pulses at point A is that they be of constant amplitude. This is necessary since the charge placed on capacitor C_2 is also a function of pulse height. The diode clipper, D_2, fixes the amplitude of pulses at point A.

Referring to the complete schematic (Fig. 5) it is seen that the input pulses are fed directly to the univibrator. The input-voltage sensitivity is approximately 1 volt so the circuit can be triggered directly from the G-M tube.

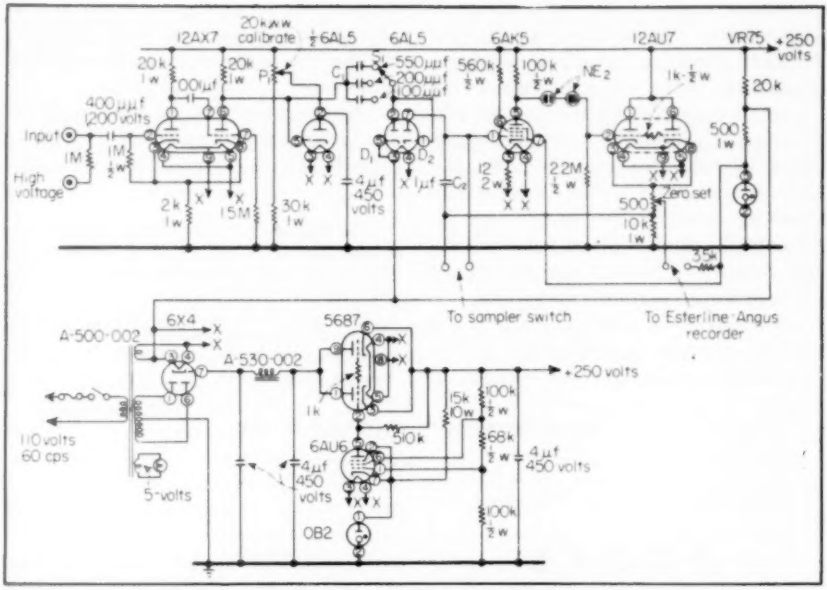


FIG. 5. Complete circuit of the integrating ratemeter

Potentiometer P_1 is an adjustment on the pulse height applied to point A, and is used to set the full-scale meter calibration. The number of pulses for full scale deflection is changed by switch S_1 which changes the size of capacitor C_1. The d-c amplifier furnishes the feedback necessary to maintain point B of the storage circuit at a fixed potential, and also serves, in conjunction with the recorder, as a vacuum-tube voltmeter.

Since the sample counting time is approximately 1 min in this system, the storage capacitor C_2 must have a very high leakage resistance. Capacitor C_2 is discharged at the end of each counting cycle by the microswitch actuated by the cam on the changer driving wheel. To prevent residual energy from remaining on the capacitor, a low-hysteresis dielectric is essential. For these reasons, C_2 is a special polystyrene capacitor.

Some charge will accumulate on C_2 as a result of grid current from the 6AK5 d-c amplifier tube. To decrease the grid current to a negligible value, a 12-ohm resistor is inserted in the filament circuit of the 6AK5 to cut down the filament potential. The two bulbs, NE2, are used for direct coupling in the d-c amplifier without loss of d-c signal.

Operation and Calibration

All samples are numbered in order individually before stacking. Having set the G-M tube voltage on the plateau and zeroed the recording circuit, the operator has merely to turn on the motor switch to begin the first cycle. A scale selector on the ratemeter enables the operator to select a scale for the entire counting load. Recording and restacking of all samples is automatic; the operator has only to mark the first sample on the recorder chart.

Calibration of the ratemeter can be

done with a pulse generator or an auxiliary scaler. Calibration with a scaler requires a constant source such as uranium-glass chips. This source is inserted in a sample holder and placed in the counting position. By connecting the G-M tube to the other scaler, the actual background of the shield and the counting rate of the source can be measured. Knowing the exact counting rate, the operator can adjust the voltage to the recorder to simplify the scale calibration. Other scale ratios will be directly in proportion to the ratios of the values of the capacitors C_1.

Zeroing of the ratemeter is done with the zero adjustment knob on the front of the ratemeter during the shifting cycle.

The chart can then be read in counts per minute, or for a given set of samples, directly in disintegrations per minute.

• • •

The authors wish to extend grateful acknowledgment to Louis Kudrle, William H. Bishop Jr., and W. Higinbotham of the Department of Instrumentation and Health Physics for their helpful mechanical suggestions and criticisms. This work was performed under the auspices of the Atomic Energy Commission.

BOOKS

Radiochemical Studies: The Fission Products (Div. IV, Vol. 9, of National Nuclear Energy Series; 3 books in the set) edited by Charles D. Coryell and Nathan Sugarman, McGraw-Hill Book Co., Inc., New York, 1951, lxv + 2,086 pages, $18.50 per set.

This reviewer cannot resist the term monumental in describing the collection of papers on fission products and related subjects compiled from the records of the Manhattan Project and edited by Professors Coryell and Sugarman. The publication is massive (4.0 kilograms), impressive (3 books, 336 individual papers, 9 editorial introductions to the several subdivisions, and 4 appendices), and undoubtedly will serve as a tribute to the wartime work of the many separate authors. It must also be considered a monument to the zeal and devotion of the editors, who have completed a herculean labor, and who surely selected with special implication the date of the volume editors' preface Thanksgiving, 1950.

Book 1 contains parts I, II, III, and IV, dealing respectively with *Counting Techniques, Chemical Studies at Tracer Levels, Remote Control Techniques,* and *Studies of the Fission Process.* Book 2 contains a portion of part V, *Radioactivity of the Fission Products.* Book 3 contains the remainder of part V, and parts VI, VII, and VIII, which deal with *Radiochemistry of the Fission Product Elements, Special Studies of Gaseous Fission Products,* and *Radiochemical Studies of Other Activities,* respectively.

Of the three volumes, Book 1 will probably be of greatest interest to the reader who has a general concern with radiochemistry, but who is not a specialist in fission products.

The discussions of counting instruments and techniques cover a number of problems often encountered in the laboratory, especially in connection with absolute beta counting. There is considerable discussion of the determination of beta energies by absorption measurements. In this connection, it is intriguing to see a paper that describes a semi-theoretical synthesis of a

typical beta absorption curve and from it a Feather analysis curve resembling those experimentally obtained. (In later sections a number of Feather curves are reproduced; it is a little disturbing to see in some of them considerable curvature projected into the extrapolated portion. The reviewer is informed, however, that this is part of the art.)

The section on chemical studies at tracer levels presents some work on the coseparation of fission products with nonisotopic precipitates and a number of papers on the chemical effects of nuclear transformations and the chemical behavior at very low concentrations (10^{-10} formal and less). The principles of enrichment of neutron-induced activity by Szilard-Chalmers reactions are discussed in reference to pile irradiations, in which back reactions caused by the high radiation level are important. Many of the papers in this section will suggest additional experimentation on the fascinating but little understood chemical behavior of atoms formed by nucleogenesis in states of high energy and very low concentration.

The section on remote-control techniques describes a number of devices and methods for carrying out chemical manipulations when the radiation levels do not permit the experimenter to have close personal access to the sample. Some of these are of quite general utility. There is also much sound advice about setting up laboratory facilities for working with various levels of radioactivity.

Part IV deals mostly with questions of gross decay rate and energy evolution in unseparated fission-product mixtures as a function of time, a subject of technical interest. In addition, some early work is presented on measurement of the ranges of individual fission fragment species, and the correlation of range with mass number, a development which has since proved fruitful in the sharper characterization of individual fission products. A number of experiments with negative result in a search for radioachemical evidence of triple fission are described. The section concludes with a discussion of the general problem of the distribution of charge in the primary fission process.

The 173 papers of Part V describe the characterization of individual fission products and the chains in which they occur. To quote from the editors' introduction, "The papers cover the search for radioactive species; the identification of these species by half-life, mode of decay, and genetic relations with other species; the assignment of mass number; and the evaluation of fission yield, especially for U^{235} with pile neutrons." This is by far the longest of the eight main subdivisions of the work and, proceeding as it does from one element to another (zinc to europium), the most forbidding to the casual reader. However, let it be said that the section is not for the casual reader, but is rather for the specialist who wishes to inform himself about the Manhattan Project work on a particular fission product and then to go on from there.

Besides the treatment of individual isotopes formed in fission, there is a sequence of papers on the determination of absolute and relative fission-product yields in uranium and plutonium. The main body of results has been in the literature for some years now; these papers go into some of the details of the experiments on which this knowledge is based.

Finally, there is an interesting sequence of reports, most of them quite brief, on the measurement of cross sections for neutron capture of unstable isotopes which are themselves formed by neutron capture. Research on secondary-neutron capture is currently being carried out at various laboratories where high neutron fluxes are available,

and these early papers will be of interest for outlining the general pattern of such investigations.

The bulk of the chemical operations in radiochemistry consists of characteristic chemical separations, i.e., of applications of methods of analytical chemistry. Standard analytical separations must frequently be modified to achieve speed or to increase the efficiency of separation from interfering activities. Part VI is a compilation of the procedures which were devised for isolating the individual fission-product elements from fission-product mixtures.

Covering a substantial fraction of the periodic table, this compilation will be very useful to those who have occasion to separate radiochemically pure samples from mixtures of radioactive substances. (A valuable supplement will be found in the report UCRL-432 and its addenda, on "Chemical Procedures Used in Bombardment Work at Berkeley," compiled by W. W. Meinke.) In further applications of these procedures, additional modifications and improvements will undoubtedly suggest themselves.

Isotopes of krypton and xenon are important fission products. As special topics, the editors have included in Part VII studies on methods of separating these gases from aqueous solutions and from uranium metal, techniques for collecting their radioactive descendants, an investigation of the fractions of fission chains removed from U^{235} and Pu^{239} solutions by rapid separation of noble gas ancestors, and related matters.

To complete the record of the work of various fission-products groups, in the Manhattan Project, Part VIII presents a collection of reports on studies of radioactive materials other than fission products. These describe various isotopes formed by (n,γ), $(n,2n)$, and (n,p) reactions in the pile, and also some cyclotron work. There is a paper on secondary (t,n) reactions in the nuclear reactor, brought about by tritium nuclei produced in the reaction of neutrons with Li^6.

Book 3 concludes with appendices which list known fission-product decay chains; yields of fission products from various fissionable materials; nuclei formed in thermal fission, and their radioactive decay properties; and the authors of the collected reports.

The researches reported were carried out during the period 1942–1946, and in many cases the numerical data are superseded by more accurate results obtained since that time. The editors have added to the usefulness of the collection by indicating these cases and citing the results of more recent work.

Like other volumes in this series, the present work is a combined historical record and scientific treatise; the two aspects have been well woven together. Judged as scientific reports, the individual papers vary in quality, interest and timeliness, as they do in length. In toto, however, the three volumes constitute a very valuable reference work, which all workers in radiochemistry and many in other fields will wish to consult, and more than a few will wish to own.

—Richard W. Dodson
Chemistry Department
Brookhaven National Laboratory
Upton, New York

Phase Transformations in Solids, edited by a committee composed of R. Smoluchowski, chairman, J. E. Mayer, and W. A. Weyl, John Wiley & Sons, Inc., New York, 1951, x + 660 pages, $9.50.

Scientists working in such diverse fields such as physics, chemistry, crystallography, metallurgy, ceramics, and glass have one common interest: the fundamental phenomenon of phase transformation.

The purpose of this book, which contains 17 papers originally presented at

the four-day Conference on Phase Transformation held at Cornell University in August, 1948, is to give a review of the latest research on phase changes in the various fields mentioned above. The papers can be divided into three main groups: theoretical-physical, nonmetals, and metals.

Theoretical-physical papers. L. Tisza's paper introduces the mathematically minded reader to some new aspects of the *General Theory of Phase Transitions.* The theory is developed from fundamental principles of thermodynamics and is based on the so-called fundamental relation of Gibbs, expressing the internal energy as a function of extensive parameters. The theory is also used for a classification of phase transformations.

In *A General Method for Imperfect Crystals and Phase Transitions,* J. E. Mayer develops a new approach in the treatment of imperfect crystals. The author does not consider one single imperfect crystal but the average properties of an assembly of imperfect crystals in thermodynamic equilibrium. The average of this assembly corresponds to a perfect crystal in which single average atoms occupy each lattice site.

This is followed by a paper by J. G. Kirkwood which, quite concisely, describes new results in the treatment of *Crystallization as a Cooperative Phenomenon.* According to the author, even in the case of a gas of hard elastic spheres, there will be a transition point at which a process resembling sublimation will occur.

F. Seitz describes his new general theory in *Fundamental Aspects of Diffusion in Solids.* He succeeds admirably in summarizing the generalized mathematical framework that can take into account at least qualitatively many of the factors affecting diffusion. After describing the mechanism of diffusion, he presents a simple statistical and a formal theory of diffusion based on the work of Wigner and Eyring on the rate of chemical reactions.

An outstanding contribution is R. Smoluchowski's chapter on *Nucleation Theory.* He discusses fluctuations (i.e., transient local deviations from normal state) in equilibrium and nonequilibrium conditions and their effects on the appearance of nuclei. Because of the general nature of the book, the author has avoided a comprehensive mathematical treatment of the subject. The *Crystallographic Aspects of Phase Transformations* as described by M. J. Buerger offers an interesting insight into the transformation mechanism. He correlates general thermodynamic features with specific structural characteristics and develops a system for classification of transformation in crystals.

Nonmetals papers. O. K. Rice discusses *The Solid Liquid Transition in Argon.* This paper gives a fairly comprehensive account and correlation of the properties of the solid and liquid material needed to understand the melting phenomena. A partition function is set up for the liquid which has a part that arises from vibrational motion. This depends on the characteristic temperature and thus serves as a link with the solid. Although no claim is made for finality, it can be said in a certain sense that a theory of melting has been attained.

M. L. Huggins treats the important subject of *Transitions in Silver Halides* and describes mainly his own work in that field. The chief attractive forces are coulombic, hence the silver halides can be considered as examples of ionic crystals; yet, in the iodide, at least, there are considerable contributions of electron-pair bond forces.

The next two papers concern silicate systems and are rich in experimental data. F. C. Kracek discusses the *Phase Transformations in One-Component Silicate Systems* and gives char-

(Continued on page 88)

NUCLEONIC EVENTS

CONGRESS GIVES APPROVAL TO BILL TO SHARE NONWEAPONS ATOMIC DATA WITH ALLIES

In a unanimous, urgent report to Congress last month, the Joint Congressional Committee on Atomic Energy recommended two amendments to the Atomic Energy Act which would permit wider exchange of nonweapons data with nations that do not threaten American security. The committee indicated its belief that such nations "could furnish as a direct result of the information tangible benefits to the United States which would substantially promote our own atomic preparedness."

Acting on the report without delay, the Senate passed the two amendments unanimously on October 11, and the House completed Congressional approval of the bill on October 12. It was expected that the measure would be signed by the President without delay.

Research data on such matters as reactor development, production of fissionable materials, and refining, purification, and treatment of source materials are the type of information which could be transferred under the bill's provisions. No information on atomic weapons would be exchanged.

Arrangements, as made by the Atomic Energy Commission under the plan, would have to be "specific" and be approved in writing by the National Security Council and the President upon information supplied by the Joint Committee.

The Atomic Energy Act, as passed in 1946, provides that "there shall be no exchange of information with other nations with respect to the use of atomic energy for industrial purposes." An agreement made in 1948 permitted exchange with Great Britain and Canada of certain limited atomic data but not for industrial or military purposes. Under the amendments enacted, these and other friendly nations will be permitted to enter into similar and extended agreements if they can show "adequate" security standards.

No specific nations were named in the committee's report as possible participants in the agreements, but it is generally known, for example, that information on Great Britain's nuclear reactors, some of which are superior to those in the United States, would be of great value to our country's reactor-development program.

AEC OFFERS 8 FELLOWSHIPS IN INDUSTRIAL MEDICINE

Last month the Atomic Energy Commission announced it will offer eight fellowships in industrial medicine for the 1952–53 academic year. The purpose behind the fellowships is to provide advanced training and on-the-job experience to men and women physicians in the field of industrial medicine, particularly in relation to the atomic energy industry.

Awards are for one year's academic training at approved institutions. After completion of this training, fellows will be eligible to apply for a second year's in-plant training at one of the major installations of the AEC. The

stipend for the first year's training will be $3,600, plus tuition and laboratory fees, and for the second, or in-plant, year, $5,000. The fellow assumes no obligation to take the on-the-job year of training or to seek employment with the AEC or its contractors.

Fellowships are open to citizens of the U. S. who hold an M.D. degree from an approved medical school and who have had at least one year of internship.

Applications for the 1952-53 fellowships should be submitted by next January 1, to: AEC Fellowships in Industrial Medicine, Atomic Energy Project, University of Rochester, School of Medicine and Dentistry, Rochester, N. Y., Attention: Dr. H. A. Blair.

Fellows are selected by a committee headed by Dr. A. G. Kammer, head of the Department of Occupational Health, University of Pittsburgh Graduate School of Public Health, and medical director of the Carbide and Carbon Chemicals Company. The University of Rochester administers the fellowship program for the AEC.

RADIATION HEALTH HAZARDS INCLUDED IN USPHS WORK

The investigation of health hazards in the production, processing, and handling of radioactive materials and radiation-producing processes have become an important new concern of the Public Health Service, according to a recent statement by Federal Security Administrator Oscar R. Ewing.

The work is being undertaken by the Service's Division of Occupational Health (formerly Industrial Hygiene) in connection with a comprehensive program revealed last month by Mr. Ewing for the additional protection of the health of American workers.

Radioactive materials are being used, Mr. Ewing said, "by such a great variety of industrial establishments today, many of them small, that the closest attention must be given to the development and intelligent use of proper safeguards."

NEW AEC RESEARCH BUILDING COMPLETED AT AMES LAB

Construction of a new research building, costing about $2,000,000, has recently been completed on the campus of Iowa State College, Ames, Iowa, according to a joint announcement by the Atomic Energy Commission and the college, which operates Ames Laboratory for the Commission.

The building is of utilitarian design, has four stories and basement, with a floor area of approximately 100,000 sq ft. It is expected to provide "facilities for intensified study in ten or more scientific fields of extreme interest to the national atomic energy program."

IN BRIEF

➤**The Aquatic Biology** Laboratory being built at G.E.'s Hanford Works in Richland, Wash., is expected to be completed late next spring. It will be a one-story building, 79 by 116 feet, and is being built by the Erwen Construction Company of Pasco, Wash., under a $362,270 contract.

➤***Part-time courses*** *for technical personnel employed at the Oak Ridge National Laboratory are being given as part of an extension program of the Oak Ridge School of Reactor Technology. The program, which provides ORSORT training for qualified ORNL staff members who are not able to attend the school full time, includes nuclear physics, metallurgy, and ceramics as subjects in a 36-week course. Sixty-one staff members are already enrolled for the training.*

➤**$6.3-billion** have gone into the atomic-energy program in this country. The Manhattan Engineer District spent

$2.2-billion, and the AEC through June 30, 1951, spent $2.7-billion. Unexpended Commission funds as of the same date totaled $1.4-billion.

➤ ***A second reactor*** *recently went into operation at Sellafield, England. Finished ahead of schedule, it, like the first Sellafield reactor started up earlier this year, will produce plutonium.*

➤ **Irradiated samples** of milk and beefsteak, sealed in plastic bags and kept at 77° F for over three weeks, showed no signs of spoiling, according to Lloyd E. Brownell of the University of Michigan's Engineering Research Institute where the experiments were recently conducted. The samples were exposed to gamma rays from cobalt-60 and X-rays. The research is being carried on by the university in an effort to find practical industrial uses for gross fission products.

➤ ***Uranium City*** *is the name of Canada's newest town. It is in the province of Saskatchewan, location of many of the newly productive uranium mines which are supplying Canadian pitchblende to the United States. There is so much uranium-mining activity under way in the province, it is reported, that the government has decided to change Saskatchewan's slogan from the "Wheat Province" to the "Uranium Province."*

➤ **Engineering** and construction work on new electronic instruments for the Los Alamos Scientific Laboratory is to be performed by the University of Denver Institute of Industrial Research. The work will be carried out under a contract amounting to about $80,000, let by the University of California, which operates Los Alamos for the government.

➤ ***Shock resistance*** *of a naval atomic-power plant will be determined soon by installing a dummy reactor in an uncompleted submarine hull which will be submerged and attacked with depth charges. The hull expected to be used is that of the* Ulua, *a sub on which work was suspended in 1945 when it was only half completed.*

NUCLEAR NEWSMAKERS

Edward R. Tompkins has been named acting head of the chemical technology division of the Naval Radiological Defense Laboratory, San Francisco, Calif.

Glenn T. Seaborg, of the University of California, Berkeley, has been elected chairman of the division of physical and inorganic chemistry of the American Chemical Society. **G. E. Boyd,** of the Oak Ridge National Laboratory, has been named chairman of the division of colloid chemistry.

Arnold O. Beckman, of the National Technical Laboratories, South Pasadena, Calif., has been elected president of the Instrument Society of America.

T. Keith Glennan, member of the Atomic Energy Commission, last month received the honorary degree of doctor of engineering from Stevens Institute of Technology. The ceremony took place following the inauguration of **Jess Harrison Davis,** former president of Clarkson College of Technology, as Stevens' new president.

Sir James Chadwick, noted British nuclear scientist, was honored on October 17 by the Franklin Institute, Philadelphia, Pa., at which time he was awarded the Franklin Medal. This award goes annually to the scientist who did the "most to advance a knowledge of physical science or its application." He is Master of Gonville and Caius College, Cambridge.

Ralph E. Davison, Vice Admiral, U.S.N. (Ret.), has been appointed administrative assistant to the manager

of the engineering and production section of the Knolls Atomic Power Laboratory, Schenectady, N. Y., which is operated by the General Electric Co. Until recently, following his retirement from the Navy in 1948, Admiral Davison was manager of engineering and construction at G.E.'s Hanford Works, Richland, Wash.

George V. LeRoy has been appointed associate dean of the University of Chicago's division of biological sciences and associate professor of medicine. Dr. LeRoy, a 1934 honors graduate of Chicago's medical school, recently supervised the biomedical program of the Eniwetok atomic-weapons tests and prior to that directed the work of the radioisotope unit at the Veterans Administration Hospital at Hines, Ill.

John T. Burwell, Jr., has been appointed assistant to the director of research of Horizons, Inc., in Cleveland, O. He was formerly on the faculty of the Department of Mechanical Engineering at Massachusetts Institute of Technology.

Wendell C. Peacock, one of the five scientists who founded Tracerlab, Inc., in February, 1946, was recently elected its vice president and technical director, and a member of the board.

Paul L. Copeland has been appointed acting chairman of the physics department at Illinois Institute of Technology. He will temporarily fill the vacancy left by the recent death of James S. Thompson.

Brig. Gen. James McCormack, Jr., who served as the AEC's first Director of Military Application, has left the Commission to take up U. S. Air Force assignments as a special assistant to the Deputy Chief of Staff for Air. Named to succeed him as Director of the Division of Military Application is his one-time aid, **Col. Kenneth E. Fields.** Colonel Fields is well known to the atomic-energy program, having served as assistant to the Commanding General, Manhattan Project, from 1945 to 1947, and as assistant to the Director of Military Application from 1947 to 1949.

B. F. Ruth and **J. S. Fritz** have joined the staff of the Institute for Atomic Research of Iowa State College. Dr. Ruth was formerly associated with the chemical engineering department of the college. Dr. Fritz is a former member of the staff of Wayne University, Detroit, Mich. At the Institute, he will serve as assistant professor and group leader in analytical chemistry.

Davis R. Dewey, II, has been appointed vice president of High Voltage Engineering Corporation, Cambridge, Mass. Dr. Dewey was previously associated with the American Research and Development Corporation and Ionics, Inc.

MEETINGS

American Physical Society—Houston, Texas, Nov. 23–24

American Society of Mechanical Engineers, Annual Meeting—Chalfonte-Haddon Hall, Atlantic City, N. J., Nov. 25–Dec. 1

Conference on Laboratory Design for Handling Radioactive Materials, sponsored by American Institute of Architects and Atomic Energy Commission—National Academy of Sciences, Washington, D. C., Nov. 27–28

American Institute of Chemical Engineers—Atlantic City, N. J., Dec. 2–5

Institute of Radio Engineers, Conference of the Professional Group on Nuclear Science—Brookhaven National Laboratory, Upton, N. Y., Dec. 3–4

American Association for the Advancement of Science—Philadelphia, Pa., Dec. 26–31

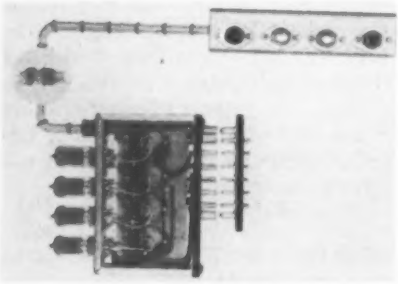
Symposium on Nucleation (sponsored by Division of Industrial and Engineering Chemistry of the American Chemical Society)—Northwestern University, Evanston, Ill., Dec. 27–28

American Physical Society—Berkeley, Calif., Dec. 27–29

Fourth Annual Conference on Electronic Instrumentation in Nucleonics and Medicine (sponsored by American Institute of Electrical Engineers)—Hotel Commodore, New York, Jan. 7–8

American Physical Society—New York, N. Y., Jan. 31–Feb. 2

PRODUCTS and MATERIALS



MINIATURE COUNTER DECADES

Potter Instrument Co., Inc., 115 Cutter Mill Road, Great Neck, L. I., N. Y. Two models of this electronic counter decade are available. The Model 12 will count at rates up to 130,000 c/sec; the Model 13 will count up to 30,000 c/sec. On each model, four indicator lamps are arranged in 1-2-4-8 decimal coding. The counter stages are so arranged that the progression of count cannot skip over a stage in which a tube failure has occurred. The decade is easily adaptable to computer circuitry and to recording devices that use four stylii. Available as separate units, the decades can also be obtained incorporated in standard and custom-designed counting, timing, and computing instruments.

OSCILLATOR-AMPLIFIER

Brown Electro-Measurement Corp., 4635 S. E. Hawthorne Blvd., Portland 15, Ore. The Model 855-A oscillator-amplifier provides d-c voltages for resistance measurements, a vacuum-tube generator for a-c impedance measurements, and a vacuum-tube amplifier with a cathode-ray tube for visual null indication. Plug-in networks allow the oscillator to be operated at any frequency from 100 cps to 10 kc; oscillator frequency is said to be within 1% of the nominal frequency. The open circuit output voltage is adjustable to a maximum of about 15 volts. The d-c supply furnishes 10 volts at 250 ma for low-resistance measurements, and 200 volts at 10 ma for high-resistance measurements. Flat amplifier response or peaked response at any frequency from 100 cps to 10 kc is provided for the null amplifier. Second-harmonic rejection is about 18 db, it is claimed. The amplifier gain is adjustable to about 60 db.

MANOMETER AND FLOWMETER

Hastings Instrument Co., Inc., Hampton, Va. This sensitive electronic manometer and flowmeter operates from a noble-metal thermopile; it has no glass or plastic tubes and contains no fluids. The two taps on the gage tube are connected to the two points at which the pressure difference is to be measured. For measuring low flow rates the tube is placed directly in the line; for high flow rates the connection is made to pressure taps on two sides of a cali-

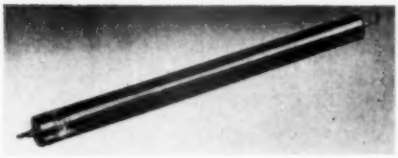
brated orifice. The manometer has two ranges, the lower will give readings from 0.001 to 0.1 in. of water, the higher from 0.1 to 2 in. of water. Calibration and accuracy are not affected when long extension cables are used between the gage tube and the meter.

SINGLE-SWEEP ACCESSORY

Sterling Instruments Co., 13331 Linwood Ave., Detroit 6, Mich. The Type 121 single-sweep accessory is designed to provide one and only one pulse to trigger the single sweep of an oscilloscope at the start of any complex wave pattern, and at no time thereafter. A single negative output pulse results from either a positive or negative input signal. An input of about 0.1 volts is required. Reset is by means of a panel switch or by remote control through a cable.

DOSIMETERS

Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Cal. The pocket dosimeters models L-31, L-32, and L-33, have ranges of 5, 10, and 50 r, respectively. The barrels are of conducting laminated bakelite, and the instruments are hermetically sealed. The flexible plastic charging diaphragms will not crack from use or age. These direct-reading instruments are designed to be charged with the model L-21 battery-operated charger.



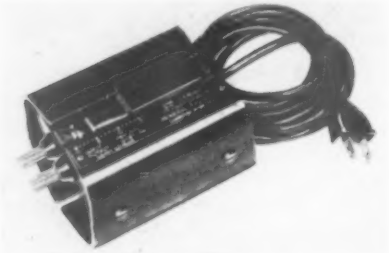
INDUSTRIAL GAMMA TUBE

Tracerlab Inc., 130 High St., Boston 10, Mass. The TGC-16 industrial gamma tube is especially designed for industrial process-control procedures, and for cosmic ray counting. Absence of flanges, bases, and base pins makes the tube adaptable for a wide variety of uses. Wall thickness is about 400 mg/cm^2. It is claimed that the life of the tube is more than 2×10^8 counts. Starting potential is 870–930 volts; minimum plateau length is 200 volts with a slope of about 1% per 100 volts. The fill gas is helium with an organic quench. Recovery time is about 200 μsec. The standard sensitive length is 12 in. but the tube may be obtained with lengths from 5 to 20 in.

FREQUENCY COUNTER

Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif. The Model 524A frequency counter is capable of measuring and displaying low, medium, and high frequencies up to 10^6 cycles per sec. Operating on a pulse-counting technique, the instrument presents instantly and directly on the front panel the exact frequency of each unknown measured. No interpolation is required. For frequencies above 300 cps, the instrument counts and displays the unknown directly. A switch enables the operator to select counting intervals of 10, 1, 0.1, 0.01 and 0.001 sec. The instrument counts the frequency cycles occurring during the interval selected, then displays the frequency. For low frequencies, the instruments measures the duration of 10 cycles, and then presents the duration

of a single cycle in μsec. The instantaneous stability of the time base is 1 part per million; the accuracy is 2 parts per million per week, it is claimed.



LOW-VOLTAGE TRANSFORMER

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. The Type 71-A Variac transformer furnishes an adjustable source of low-voltage, 60-cycle power. The continuous output current rating is 5 amperes with an output voltage range of 0–13 volts; input is 115 volts, 60 cycles. The secondary winding is completely isolated and the insulation between coils, and to the core, will withstand a 1,250-volt breakdown test.

POWER SUPPLY

Kepco Laboratories, Inc., 149-14 41st Ave., Flushing, N. Y. The model 1250 furnishes continuously variable voltage in the range 200–1,000 volts and delivers from 0–500 ma. In this range the variation is said to be less than ½% for line fluctuations from 105–125 volts and for load variations over the maximum range. Ripple is less than 20 mv, it is claimed.

MICROSCOPE

William J. Hacker and Co., Inc., 82 Beaver St., New York 5, N. Y. The model MeF camera microscope is designed for metallurgical work. Magnification ranges from 4.5 to 2,200; a built-in camera is provided. A Gauss mirror is used for internal illumination. Instant change-over from bright to dark ground illumination may be made; instant transition from visual observation to photography and from ordinary to polarized light may also be made.

LITERATURE AVAILABLE

Equipment and isotopes. Catalog C gives complete information on equipment, sources, and labeled compounds available. *Tracerlab, Inc., 130 High St., Boston 10, Mass.*

Flow-rate calibration. Catalog 100 describes flow-rate calibration services. *Fischer and Porter Co., 1712 County Line Rd., Hatboro, Penna.*

Recorders. Brochure shows mechanical recorders. *Streeter-Amet Co., 4101 N. Ravenswood Ave., Chicago 13, Ill.*

Instruments. Instruments available are described in new catalog. *Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass.*

Low-resistance testers. Bulletin L-12 describes line of low-resistance test sets and milliohmmeters. *Shallcross Mfg. Co., 10 Jackson Ave., Collingdale, Penna.*

Expansion joints. Catalog gives data on expansion bellows and applications. *Solar Aircraft Co., 2200 Pacific Highway, San Diego 12, Calif.*

Miniature batteries. Technical Brochure No. 1 gives data on line of Silvercel batteries. *Yardney Electric Corp., 105 Chambers St., New York 7, N. Y.*

Photographic analysis. Brochure describes photographic analysis service. *Photographic Analysis Co., 582 E. 7th St., Brooklyn 18, N. Y.*

Electroforming. Booklet shows parts that can be formed by electroplating process. *Bart Laboratories Co., Inc., 227 Main St., Belleville 9, N. J.*

GENERAL ELECTRIC

Headquarters for RADIATION LABORATORY EQUIPMENT

Described in the following pages are some of the important G-E equipments, components, and materials designed specifically for nuclear research. General Electric scientists, engineers, and researchers are ready to meet many of the exacting needs of this fast-developing field.

EQUIPMENT AND COMPONENTS AVAILABLE

Accelerators, Particle
Alnico
Ammeters
Amplifiers
Chambers, Ionization
Controls, Liquid Level
Controls, Millivoltmeter
Controls, Motor
Controls, Pressure
Controls, Remote
Controls, Servo
Controls, Temperature
Counters, Alpha
Counters, Beta
Counters, Gamma
Counters, Neutron
Counters, Proportional
Counters, Radiation
Counters, Scintillation
Counters, X-ray
Crystals, Scintillation
Detectors, Alpha
Detectors, Beta
Detectors, Gamma
Detectors, Leak
Detectors, Neutron
Detectors, X-ray
Furnaces, Electric
Gages, Ionization
Galvanometers
Heaters, Induction H.F.
Instruments, Recording
Insulators, Quartz
Magnetizers
Meters, Survey, Radiation
Meters, X-ray Intensity
Microammeters
Milliammeters
Monitors, Area
Monitors, Personnel
Motor-generators
Motors, Fractional-hp
Oscillographs
Oscilloscopes
Plastics, Protective
Power Supplies, Regulated
Pyrometers
Recorders, Radiation
Relays, Sensitive
Remote Handling Devices
Silicone Grease
Silicone Rubber
Spectrometers, Mass
Thermocouples
Timers
Transformers
Tubes
  Electrometer
  Geiger
  Ignitron
  Mass-spectrometer
  Photomultiplier
  Rectifying
  Thyratron
  Voltage-regulating
  X-ray
Tubing
Voltmeters
Ware, Glass & Quartz
X-ray Diffraction Apparatus

The G-E Handbook "EQUIPMENT FOR RADIATION LABORATORIES" is available to key engineers and scientists in the nuclear-energy field. Ask for Handbook SW-65 on your company's letterhead, addressed to General Electric, 1 River Road, Schenectady 5, N. Y.

GENERAL ELECTRIC

Alpha, Beta, Gamma Scintillation Counter

Detects presence of alpha, beta, or gamma particles and can be used to measure the disintegration rate of any sample (up to 2-in. diameter) which fits into chamber. Used for low-background alpha counting and high-efficiency beta and gamma counting. Essentially zero spurious background count. Uses solid or liquid phosphor. Forty-five per cent counting geometry for alpha particles. No microphonics. Sample is placed on slide, nuclear particles strike a phosphor, causing scintillations which are detected by the 5819 photomultiplier tube. Accommodates wide variety of phosphors. Phosphors can be rapidly interchanged. The output of the photomultiplier is coupled to a preamplifier which, in turn, is coupled to a standard scaler (not supplied). The positive high-voltage supply of the scaler is utilized for the operation of the photomultiplier tube. The cathode follower preamplifier provides for maximum simplicity and stability. Can be used with any standard make or scaler.

When Counting Alphas:

Background: In the order of 1 or 2 counts per hour; Geometry: Not less than 45%; Resolving Time: Approximately 5 microseconds; Operating Voltage: About 900 volts.

When Counting Betas:

Background: About 30 to 40 counts per minute; Geometry: About 40%; Resolving Time: 5 microseconds; Operating Voltage: About 1050 volts.

When Counting Gammas:

Background: Caused by tube noise, essentially zero; Sensitivity: About 50,000 counts per minute per milliroentgen per hour; Resolving Time: 5 microseconds; Operating Voltage: About 1050 volts.

Portable Alpha Survey Meter

A small, rugged light-weight instrument, completely self-contained, for detection and indication of alpha radiation. Utilizes a proportional-counting chamber as the detector. Output of this detector is fed through appropriate electronic circuits to a meter and to headphones.

Has direct indication — semilog meter covers two decades without range switch. Has low background. A health monitor for alpha contamination. Range: 0-10,000 disintegrations per minute. Energy Range: Calibrated from 4 to 5 mev. Accuracy: plus or minus 10% of indicated reading. Alpha window: Less than 2. mg/cm^2.

Weight: Approx 7½ lb, less headphones

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

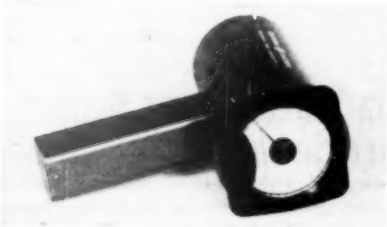
GENERAL ELECTRIC

Long-probe Gamma Survey Meter

For use in areas where high-level monitoring and survey work is done. Consists of gun-type probe and power supply. Detecting probe head is scintillation type. Instrument may be "zeroed" in presence of radiation through the use of a light shutter. The long probe affords maximum protection; lightweight and completely portable with easy-to-read indicating meter. A range switch provides five scale ranges (0-0.3 r/h; 0-3 r/h; 0-30 r/h; 0-300 r/h; 0-3000 r/h).

Pocket-chamber Electrometer

An extremely high-quality, self-balancing electrostatic potentiometer designed for rapid, accurate and trouble-free reading of "pencil" type pocket ionization chambers. Equipped with standard 3-in. meter for direct measurement in two ranges: 50 and 250 milliroentgens. Sensitive element is a reflecting electrometer using quartz-fibre suspension in self-contained cartridge unit. Input resistance greater than 10^{17} ohms. Input power: 105-125v, 50/60 cycles, approx 40w. Requires no batteries, has an accuracy at 2% of full scale in terms of voltage. Ambient temperature: 0-40 C. Meter indicates rapidly without overshoot.



Gamma Survey Meter 4SNI3A1

A small, light-weight, inexpensive gamma survey meter for use in nuclear laboratories, X-ray and particle accelerator installations, and in civilian-defense activities. An outstanding feature of the 4SNI3A1 is the long meter scale which measures 4 inches. Three decades of indication are provided. Range: 0-25 roentgens/hr.; Accuracy: ± 25% over entire scale and over specified battery life; Long scale length — easy readability; Three decades without range change; Automatic cut-off switch — no accidentally run-down batteries.

FEATURES:

- Good spectral response
- Calibration in roentgens/hour
- Easily zeroed in radiation field
- Ion-chamber detector
- Fast response

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

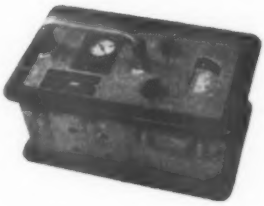
GENERAL ELECTRIC

Radiation Monitor Model 4SN11A2

An integrating self-charging device for measuring milliroentgens of gamma radiation. An easily read pointer-type electrostatic voltmeter, an ion chamber, and an electrostatic generator that requires no batteries and has unlimited life, are included in this compact unit that does not require opening for maintenance of tubes or battery, since it contains none. Great simplicity and design safety factors provide a convenient and reliable instrument. An extremely sensitive device (20 mr full scale), it will find application for health monitoring particle accelerators: medical, dental, and industrial X ray; radioisotope laboratories: and schools, and industrial processes involving radiation hazards.

Explosion-proof Ionization Chamber

A standard-type survey meter, packaged in a specially designed cast-aluminum pressurized case to make it suitable for use in Class 1, Group D, hazardous atmospheres. Pressure-actuated switch breaks all battery circuits when pressure falls below 2 lbs. per square inch. Pressurized to 15 psi., gage; provides alpha-beta-gamma detection. Has four ranges (X1, X10, X100, X1000). Maximum sensitivity 10. mr/hr radium gamma. Two slides move over ionization-chamber window and select type of radiation registered. Feedback is used to stabilize over-all operation.



RANGES:

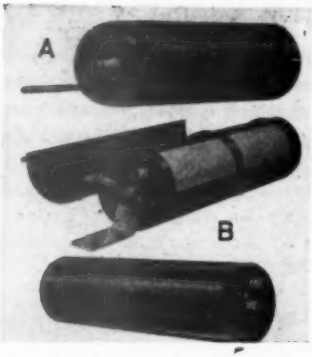
0-.5 milliroentgens/hr; 0-5 milliroentgens/hr; 0-50 milliroentgens/hr; 0-500 milliroentgens/hr.

"Range Switch" changes meter scale as ranges are switched and selects G-M tube to be used.

Beta Gamma Survey Meter

Designed for rugged use in laboratory or field. Utilizes two G-M halogen-filled tubes operating from an electronic high-voltage supply to provide extreme sensitivity over a wide range of radiation levels. Detachable probe containing sensitive G-M tube. Has potted plug-in electronic unit. Provides headphone monitoring.

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION



Ionization Chambers

High-temperature Type (A): Detects slow neutrons at ambient temperatures as high as 350 C. Also measures slow-neutron fluxes in reactor applications. It can be supplied with a coating of normal boron or, for higher efficiency, pure boron^{10} isotope. Ceramic-to-metal seals used throughout. Sensitive volume: approximately 90cc. Normal operating voltage: approximately 250 v. Filling gas: one atmosphere of argon not less than 90 per cent pure.

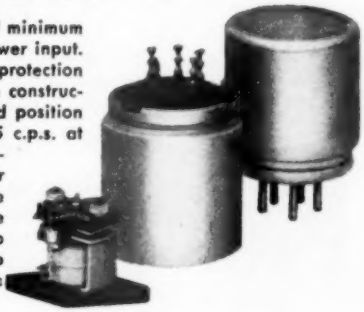
Air-wall Type (B): Three types: (1) to detect gamma and X rays, (2) beta window model to detect beta, gamma, and X rays (not shown), (3) with cover open, detects beta and gamma rays; with cover closed, detects gammas. Used in health-monitoring reactor areas, particle accelerators, and X-ray installations. Continuous record of radiation intensity obtained when used with suitable recorder. Chambers essentially free from microphonics and leakage. Plastic construction for minimum radiation energy dependence. Large sensitive volume: 4.8 liters. Drying agent built in.

Air-equivalent Type (C): Detects beta, gamma and X radiation. Can be used as primary detector of radiation. Sensitive to beta, gamma and X rays with sliding window open, gamma and X rays with window closed. Used for radiation monitoring in atomic-energy plants, health-monitoring in X-ray installations and laboratories where radioactive isotopes are handled. Calibrates radiation instruments; used in cities for CD.

Current-sensitive D-c Relays

Current-sensitive relays in automatic control equipment and safety devices are designed for use in circuits where limited power is available for energizing the coil. They are often used in control systems where the output from a pickup element is insufficient to operate a motor, solenoid, or other electric device. In effect, the relay amplifies the signal from the pickup element.

This line of relays is so comprehensive that a relay of minimum size and weight can be obtained for any listed coil power input. They have sturdy metal covers to afford mechanical protection and to keep out dust and moisture. Balanced-armature construction insures that contacts will remain in open or closed position when subjected to mechanical frequencies of 5 to 55 c.p.s. at 1/32-inch max amplitude (1/16-inch total travel), applied in any direction, or when subjected to a linear acceleration of 10g in any direction. For use in a wide range of ambient temp — from 200 F to —70 F. Can be used at rated current at altitudes from sea level to 50,000 ft Corrosion-proof. Easy to install. D-c Pickup 4 to 765 ma (40 Mw to Pick up Armature). 1.6 to 3.2 ma (5 Mw to Pick up Armature).



G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

GENERAL ELECTRIC

Binary Scaler Model 4SNIA3

Provides a scale of 2 in a self-contained plug-in unit to permit installations for industrial counting in minimum time. Suitable for interval timing and repeat cycling; has adequate speed for all ordinary nucleonic and computer applications. A modification of the common Bi-stable Multivibrator. It attenuates positive pulses and supplies a plate swing of proper rise time to trigger the next succeeding stage. Suitable for direct coupling—no intermediate stages necessary. Fits standard octal socket—speeds up to 200 kc—resolution time is 59 sec—operates from a wide range of supply voltages—210 v ± 20%.

Proportional Counters

Neutron Proportional-counter Tube: Enriched boron coated to detect slow neutrons: Can be used to detect fast neutrons, when surrounded by suitable moderator. Applications include measurement of neutron flux in reactor installations; counting neutrons produced by particle accelerators; health-physics applications. Efficiency five times that of counters coated with normal boron. Gas filling can be replaced. Free from spurious counts. Rust-proof construction. Two sizes: 1½ in. by 8 in. sensitive volume, or 1½ in. by 12 in. sensitive volume. Has high-voltage lead-through insulators. Construction provides shielding electrically and physically.

BF_3 Neutron Proportional-counter Tube: Typical Applications: measurement of neutron flux in reactor installations; counting neutrons produced by particle accelerators; health-physics applications. Filling data: 12.5 cm Hg pressure of normal BF_3 gas. 1.8 cm Hg pressure of Argon gas; operating voltage: 1500 volts maximum; life expectancy: In excess of 10^9 counts.

G-E Electronic Tubes

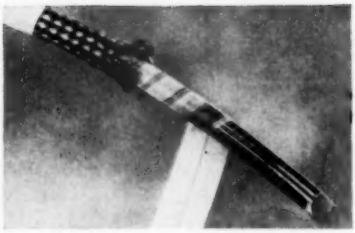
Designed for the exacting requirements of electronic circuits in nuclear equipment. Manufactured under rigid material and production control for long-lasting performance according to their ratings. The constantly changing and expanding field of nucleonics demands new tube types — G-E designs tubes to meet every need.

Electronic Tube Manual: Contains comprehensive data on electrical, mechanical, and performance characteristics of every G-E tube type. Their easy-to-read graphs and tube outlines help solve application problems. For price and information write General Electric Co., Electronics Division, Schenectady 5, N. Y.

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

GENERAL ELECTRIC

Delay Lines



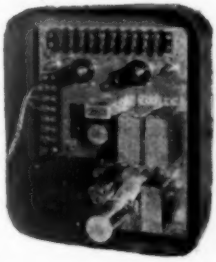
For delaying electrical signals by desired and definite amounts of time. Limitations are allowable attenuation and wave-length distortion. Line shown is most practical with maximum delay of about 10 microseconds. Delay lines are employed in lengths which give a delay from 0.25 to 3.00 microseconds. Lines may be obtained in bulk form up to 100 feet long to be cut into lengths by purchaser. Time delay per foot is approximately 0.5 microsecond.

Portable Radiation Probe

For health monitoring and research studies. Different detecting caps selectively detects and measures alpha, beta, gamma and thermal-neutron radiations from radiation sources. Incorporates all the advantages of scintillation counting. Has extremely high thermal-neutron counting efficiency. Low-background alpha counting. Operates up to 50 ft of cable. Phosphors used for detection are incorporated in the specially designed caps and can be interchanged and replaced easily.

Step-motor Impulse Counter

The General Electric step-motor impulse counter provides accurate counting from 0-60 counts per second. It is designed to cover counting ranges above those possible with electromechanical counters and below those in which scalers are normally required. May be used with a number of different radiation detectors such as geiger tubes and high-gain photomultiplier tubes. In applications that require fast counting, the step-motor impulse counter is exceptionally well-suited.



Has counting speed of 0-60 counts per second, standard range, and high accuracy in the range to 0-100. Operates on positive and negative pulses and counter may be remotely located. Has a resetting-type register.

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

GENERAL ELECTRIC

Mass Spectrometer

Automatically and accurately records concentrations over the mass range of 1 to 300 in one setting. A second setting permits analysis up to masses 600 and higher. For atomic research and analysis in chemical, petroleum, and allied industries. Can be used as an analytical tool for determining constituents of materials which are in gaseous form, and even liquids and solids which have sufficient vapor pressure (0.1 mm of Hg at room temperature or higher). Also, for the analysis of lead isotopes. Analysis time can be as low as ten per cent of that required with conventional methods.

Mass Spectrometer Tubes and Components: In addition to a variety of standard components for assisting laboratories building experimental spectrometers and modernizing existing spectrometers, G-E offers several high-frequency mass-spectrometer tubes. Bennett tubes are available in either metal or glass envelopes. These tubes require no magnet. Resolve masses to approximately mass 10, with a sensitivity of one part helium in 200,000 parts of air, ion resonance tubes are supplied with a glass envelope and require the use of a magnet. This tube resolves masses to approximately mass 40, with a sensitivity of one part helium in 40,000 parts of air.

Photoelectric Recorder

Has high sensitivity and fast response. Uses mirror-type basic element to record rapidly changing phenomena with minimum burden on the measured circuit. Records microamperes, millivolts, and watts directly; also used with accessories to measure temperature, light, speed, vacuum, magnetic flux, and other nonelectrical quantities.

Silicone Grease and Rubber

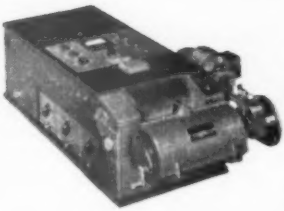
Silicone Grease: Is used in a new and interesting way. Containers used for the temporary handling of radioactive materials or liquids have to be decontaminated after they have been emptied. It has been found that, when the containers are coated with a silicone grease, decontamination is easily accomplished after the grease is removed by physical means.

Silicone Rubber: Is used as shock mounts on heavy carboys or glass flasks containing radioactive materials. These containers are quite heavy and are subjected to shock from mechanical handling which may shatter them.

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

GENERAL ELECTRIC

Oscillographs



Type PM-10: Used in the investigation, design, or testing of various machines and devices. Can record up to 12 variables at once. Simultaneous viewing and recording. Timing lines 1/60 or 1/100 second apart.

Type PM-18: Combines versatility and ease of operation with low cost. Produces finished oscillograms in one minute with Polaroid-Land film holder. Can record four quantities simultaneously. Light in weight (30 lb), entirely self-contained.

New 1952 Catalog

G-E MEASURING EQUIPMENT FOR LABORATORY AND PRODUCTION TESTING

General Electric's testing and measuring equipment intended for use in the laboratory and on the production line. Products range from simple current indicators to the completely automatic oscillographs; from roughness scales to the mass spectrometer. This 80-page catalog is to serve as a reference – to indicate briefly the many devices available for complex measurements. Simplicity is the keynote with compactness and conciseness. A brief description of each product and its field of application, condensed tables of important characteristics, and prices indicate whether or not the device is suited for the job.

Thermocouples, Components and Accessories: For use with pyrometer equipment. Includes variety of assemblies, thermocouple and extension wires, protecting tubes, wells, ceramic insulators, heads, connector blocks, and thermocouple switches.

Temperature Indicators: Housed in 3½-in. plastic case, round and square, for temperature up to 2500F. High-speed response and remote indication, 100 ft. or more from temperature source.

Indicating and Controlling

Pyrometers

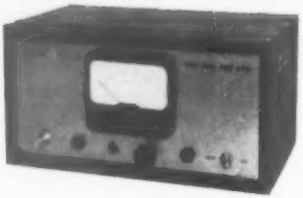
Designed for the indication and control of temperature in industrial and atomic-energy processes and for the protection of heat-process equipment. They are ideally suited for use in remote control for the processing of highly radioactive solutions. This is particularly important when these operations must be carried on behind thick radiation shielding. A pyrometer protector, used in addition to controller, protects equipment by shutting down the process at preset temperature above control point in case controller fails.

Close control of process temperature: movement of pointer equivalent to 0.1% full scale initiates instantaneous corrective action. Indicator acurate to ±0.75% full scale. Has high resistance to shock and vibration. Two or three position controllers available. Both setpoints for three-position controller *independently* adjustable. Flush or surface mounting. Automatic cold-junction compensation and thermocouple-break protection standard on all controllers and protectors.

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

GENERAL ELECTRIC

Regulated Power Supplies



Type 4ST-1A1—180 to 300 volts D-c: This G-E regulated power supply is a superior quality, low-power, electronically regulated unit designed for use in laboratories (industrial or atomic), and wherever a closely regulated d-c voltage of low-ripple content is required.

Its features include: Wide range of d-c power output; good regulation; low ripple and noise; low-output impedance; protected circuits — fuses on both input and output; metered output—4½-in. meter for measuring output current and voltage; D-c Voltage Output: 180-300 volts (positive or negative may be grounded to chassis). D-c Current Output: 0-60 milliamperes. A-c Output: 6.3 volts, 2.5 amperes unregulated, center-tapped and ungrounded. Regulation: Less than 1% of output voltage from minimum to maximum current. Ripple: Less than 10 millivolts peak to peak. Ambient Temperature: 0 to 40 C.

Type YPD-2-250 to 450 Volts D-c: Medium power, electronically regulated for use where closely regulated voltage of low-ripple content is required. Has wide range of d-c power output, good regulation, low ripple and noise. Low-output impedance, protected circuits; exclusive; easy-access front panel. Supplied in cabinet or may be mounted in standard 19-in. rack. D-c Voltage Output 250-450 volts (positive or negative may be grounded to chassis). D-c Current Output: 0-300 milliamperes. A-c Output: 6.3 volts, 10 amperes unregulated. Regulation: Less than 1% of output voltage from minimum to maximum current. Ripple: Less than 5 millivolts peak to peak.

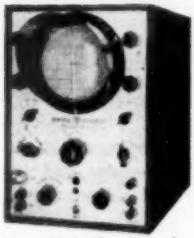
Type YPD-4 160 to 1500 Volts D-c: Provides an adjustable source of relatively high d-c voltage despite changes in load or supply voltage. The most versatile power supply available for laboratory work. High, wide range of d-c output power. Excellent regulation — low ripple and noise, low output impedance, metered output. Employs series electronic regulation so that as the d-c output voltage is varied over its range the voltage across the series regulator tubes remains almost constant. This feature provides a wide voltage range and also effective regulation, low output ripple and low a-c impedance. D-c Output Power: Voltage: 160 to 1500 volts. Current: 0 to 0.125 amperes maximum. Ripple: Maximum 0.05 volts (peak to peak value). Load regulation: 0.15 percent or less. Line regulation: 0.015 percent or less.

Oscilloscopes

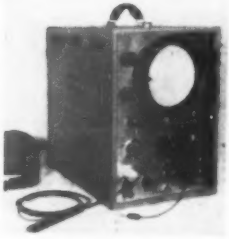
3-in. Oscilloscope—Type YNA-4: Designed especially for application where test equipment is essential for installation and maintenance of industrial electronic equipment. Measurements down to 0.5v. dc — both vertical and horizontal amplifiers are direct coupled. Has high sensitivity, excellent stability, sharp focus, low distortion, calibration circuits built in, flexible input circuit switching, expanded pattern, rugged construction and completely insulated case.

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

Oscilloscopes



5-in. Oscilloscope — Type ST-2A: A general-purpose instrument with wide frequency response. Has high sensitivity, exceptional stability, d-c amplifier, excellent linearity, low-capacity input probe, Z axis input, regulated power supply, deflection plates available for direct connection and calibrating voltages provided.



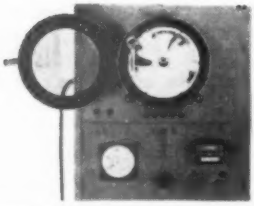
5-in. Oscilloscope—Type ST-2C: Particularly useful where wide-frequency response plus portability are required. Weight and size have been held to a minimum. Cathode-ray tube is cradled in rubber and is provided with a ¼-in.-thick green-colored safety window. All frequently used controls located on front panel and grouped conveniently according to their function. Vertical input attenuator quickly selects three levels of input from the input binding posts or three levels of input from the RC probe. Will attenuate voltages by as much as 1000 to 1 without frequency discrimination.

Its important features include: Wide-band response; good sensitivity; light weight; exceptional stability; low-capacity input probe; Z-axis input; calibrating voltages provided; deflection plates available; regulated power supply; hard tube sweep.

Hand and Foot Monitor

Provides tamperproof, rapid, and positive indication of radioactive contamination of hands and feet. An efficient, accurate health monitor for industrial plants processing radioisotopes and for radiological laboratories. A beta-gamma device that detects location and extent of contamination. A tamperproof control assures proper personnel monitoring. Either the subject or background may be monitored. A selector switch is provided to allow counting to be initiated by the subject or operator.

Area Health Monitor



Indicates, integrates, totalizes, and telemeters gamma radiation. Automatically indicates radiation above average tolerance limit (6.25 mr/hr.) Provides a 30-day integrated record. Laboratories, atomic energy plants, hospitals, and cities use it for safety and civilian-defense equipment. Range is 5 mr/hr full scale to 50 mr/hr. Accuracy ±10% in range of 50 kv to 1.5 mv. Utilizes air-equivalent-type ionization chamber (See page 5).

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

GENERAL ELECTRIC

Milwaukee 14 **X-RAY DEPARTMENT** Wisconsin

X-Ray Equipment for Radiation Research

Maximar 100: An outstanding feature of the Maximar 100 is its Coolidge tube with beryllium window. A new development that makes possible softer radiations at far higher intensities and with large field coverage. Stepless voltage and current control.

Maxitron 250: A spectral range never before obtainable in x-ray equipment, due to the use of a beryllium window in the newly developed, sealed, multisection Coolidge tube. A high roentgen output, with continuous operation, at all voltages from 100 kvp to 250 kvp, tube current up to 30 ma. Stepless-voltage control and electronically controlled tube current for accurate dose control.

KVP	MA	FILTER	DISTANCE	ROENTGENS PER MINUTE	HALF-VALUE PER MINUTE	THICKNESS OF UNIT DENSITY MATERIAL FOR 50% DOSE
MAXIMAR 100						
30	5	0	30cm	180	0.06mmAl	0.3mm
100	5	0	30cm	1000	0.08mmAl	0.7mm
100	5	3mmAl	30cm	23	3.00mmAl	28.0mm
	(Minimum distance 8cm)					
MAXITRON 250						
100	30	0	50cm	1100	0.09mmAl	0.7mm
250	30	0	50cm	2100	0.18mmAl	2.0mm
250	30	3mmCu	50cm	40	3.00Cu	70.0mm
	(Minimum distance 10cm)					

XRD-3 Logarithmic X-Ray Diffraction Unit

The XRD-3 logarithmic scale permits reading from 2 to 10,000 counts per second on a single 10-in. scale.

Having a dynamic response range of zero to ten thousand counts per second—the XRD-3 accurately records a wide range of intensities. Ratios of several thousand to one are easily visible on a single chart, contrasted to one hundred to one on a linear scale. No need to search for strongest line before beginning run. No off-scale peaks to cause repeat runs. No confusion of multiple linear-scale ranges. The XRD-3 is designed to satisfy diffraction needs for both film and direct recording techniques.

Write for booklet "Analytical Applications of X-ray Diffraction Using Direct Measurement Techniques." X-Ray Department, General Electric Company, Milwaukee 14, Wisconsin.

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

At the moment, there are under construction a $500,000,000 gaseous diffusion plant at Paducah and the $1-billion production reactors at Savannah River.

If annual AEC appropriations are upped to $6-billion, this would certainly mean the building of at least as many plants as there are at Hanford, Oak Ridge, Paducah, and Savannah River. Actually, AEC chairman Gordon Dean has stated that presently planned capacity for production of fissionable material can be increased by 150%, a figure which he says is not necessarily the maximum.

Who would spend AEC's money? Industrial contractors would certainly continue to be called on to do the work. Only 5–6,000 of the present 80–100,000 people working on the project are direct employees of AEC. During one recent 12-month period, AEC entered into nearly 11,000 prime contracts and purchase orders. The prime contractors in turn entered into more than 280,000 subcontracts and purchase orders. A 600% increase in expenditures would no doubt mean that many companies not yet involved in the program will have the opportunity to participate.

Availability of manpower, materials of construction and electric power will probably not be serious problems in the contemplated expansion. Mainly responsible for this is the top priority position which atomic energy holds in our economy. What is more likely to be the situation is that an expanded atomic energy program will cause a serious drain on the rest of our economy. For example, by the middle of 1953, power requirements for the presently planned program will probably amount to about 2½% of the total installed electric capacity of the U. S.

This is perhaps a strong argument in favor of using some part of any increased appropriation for work on a direct attack on the development of nuclear power. Then, perhaps AEC might put back in some of what it is taking out. —*J. D. L.*

Random Notes (*Continued from page 5*)

–355; structural and architectural–350; civil–345; safety–160; automotive–105; mining and metallurgical–105; heating and ventilating–100; sanitary and public health–50; refrigeration and air conditioning–40; aeronautical–25; marine engineers and naval architects–15; highway–15; petroleum and geological–8; and agricultural–2.

• *An interesting atomic energy byproduct —psychological effect—was reported at the Radioisotopes Techniques Conference held at Oxford. A Dutch firm which uses radioisotopes to test welds in pipelines found that appearance of its inspector at a particular job caused a 60% reduction in the number of defective welds which would usually be found.—J.D.L.*

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acteristics of melting, crystallization, and polymorphic transformations in silicate compounds considered as one-component systems. J. F. Schairer describes the *Phase Transformations in Poly-Component Silicate Systems.* He discusses the phenomena of congruent and incongruent melting and the relation of solid solution to these phenomena.

The *Transitions in Glass* are discussed by W. A. Weyl. The structures of most inorganic glasses are comparable with those of crystals of similar chemical composition; it is shown also that similar transitions can take place.

The recently discovered *Phase Transitions in Ferroelectrics* are discussed by B. Matthais, together with the various theories created to explain the known ferroelectrics.

Metals papers. In C. S. Barrett's paper, *Transformations in Pure Metals,* some current theories, particularly on transformations of the martensite type, are discussed and compared with recent experimental data including some not previously published. The reviewer appreciated especially the data for zirconium and other hexagonal metals.

Most informative is the paper *Order-Disorder Transitions in Metal Alloys* by S. Siegel. He discusses the electric and magnetic properties, especially the variation of saturation magnetization with temperature, and explains the kinetics of the transition. A statistical theory of the transition, although beset by computational difficulties, appears to be on a firm basis.

The chapter *Precipitation from Solid Solutions of Metals* by A. H. Geisler is a book within the book. It covers 125 pages and contains 830 references on an additional 22 pages. Aging is attributed to the precipitation process which embraces the initial formation of a transition lattice, subsequent forma-

tion of the equilibrium phase, recrystallization or recovery of a matrix, and the superimposed over-all change in composition of the matrix solid solution.

The complicated phenomenon of *The Eutectoid Reaction* is treated by R. F. Mehl and A. Dubé who include many unpublished data of the recent experimental studies on hypoeutectoid steels and offer a theory of nucleation and growth of proeutectoid constituents.

In an almost crystal clear language, M. Cohen gives a survey of *The Martensite Transformation*. He describes the diffusionless nature of this transformation and the crystallography of the martensite formation.

The book represents a most important contribution to the literature on the solid state and is highly recommended.

—HENRY H. HAUSNER
Sylvania Electric Products, Inc.
Bayside, New York

The Restless Universe (2d edition, revised), by Max Born, Dover Publications, Inc., New York, 1951, 315 pages, $3.95.

Much profit will be found by the layman and the beginning student in this discussion of basic ideas in modern physics. Max Born's prose is very readable. He manages to discuss the physics of a situation without resorting to specialized jargon. This is particularly noticeable at the beginning of the book; as he progresses, however, he is not afraid to use already explained technical terms (this is as it should be—the book is for the layman, but not the lazy layman).

The first chapter is entitled *The Air and Its Relatives*. At once the reader realizes why the universe is restless. He is introduced to collisions, to the relation between temperature and molecular velocity, to the conduction of heat, and so on. Woven into this dis-

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cussion (as in the entire book) is much solid physics.

Next comes *Electrons and Ions*, a chapter covering such fundamentals as electrolytic conduction, cathode rays, and the determination of electronic charge.

From here we proceed to *Waves and Particles*. Light waves and interference introduce the subject, light quanta take it up, atomic spectra and the Compton effect carry it on to electron waves and wave mechanics.

The Electronic Structure of the Atom follows. The hydrogen atom, as usual, is the detailed example of the theory. Not forgotten are the spin of the electron and the exclusion principle.

The last chapter, *Nuclear Physics*, takes up radioactivity, isotopes, neutrons, positrons, and the like.

Finally, there is the 1951 postscript to the 1936 original text. Here Born rapidly sketches the advances made during those 15 years. He also corrects some statements of the original text that are no longer believed correct. Fission comes in for physical, political, and ethical treatment.

Somebody had the idea that if the book were filled with strip movies (seen by flipping the pages) such phenomena as group velocity and the scattering of alpha particles would be understood more easily. Whoever had this idea was wrong. If the space devoted to these annoyingly tiny drawings were given over to some carefully drawn "stills," much more information could have been transmitted. —*A. R. L.*

BOOKS RECEIVED

Radiologic Physics (2d edition), by Charles Weyl and S. Reid Warren, Jr., Charles C Thomas, Publisher, Springfield, Ill., 1951, xix + 491 pages, $10.50. (*To be reviewed.*)

The Classical Theory of Fields, by L. Landau and E. Lifshitz, translated from the Russian by Morton Hamermesh, Addison-Wesley Press, Inc., Cambridge, Mass, 1951, ix + 354 pages, $7.50. A systematic presentation of the theory of electromagnetic and gravitational fields originally published in 1948, in Russia, under the title of "The Theory of Fields."

Biological Effects of External Beta Radiation (Div. IV, Vol. 22E, of National Nuclear Energy Series), Raymond E. Zirkle, editor, McGraw-Hill Book Co., Inc., New York, 1951, xxv + 242 pages, $3.25. (*To be reviewed.*)

OTHER LITERATURE

List of 19 Patents Released for Public Use by the AEC (Vol. I, No. 13, Sept. 17, 1951). *Issued by Chief, Patent Branch, Office of the General Counsel, U. S. Atomic Energy Commission, Washington 25, D. C.*

Fifth Annual Report of the Oak Ridge Institute of Nuclear Studies (June 30, 1951). *Issued by ORINS, Oak Ridge, Tenn.*

Symposium on Biochemistry of Nucleic Acids. Proceedings of meetings sponsored by the Biology Division, Oak Ridge National Laboratory, Oak Ridge, April 13–14, 1950, and reprinted from *J. Cellular Comp. Physiol.* **38,** Suppl. 1, July, 1951. *Issued by Reference Branch, Technical Information Service, U. S. Atomic Energy Commission, Oak Ridge, Tenn.*

Fire Fighting for Householders (PA-4, 32 pages, $0.05). Pamphlet prepared by Federal Civil Defense Administration. *GPO, Washington 25, D. C.*

Methods for Measurement of Average Values of Energy and Momentum of β-Recoils, by O. Kofoed-Hansen. A 32-page reprint from *Dan. Mat. Fys. Medd.* **26,** No. 8 (1951). *Ejnar Munksgaard, Copenhagen, Denmark, $0.75.*

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Type No.	Spectral Response	Maximum Response Wavelength Angstroms	Sensitivity† mA/mW	Equivalent Noise Input at 25°C Lumens
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1P22	S-8	4300	370	1×10^{-10}
1P28	S-5	3400	23600	$(7 \times 10^{-13}$
				$(^{*}6 \times 10^{-13}$
931-A	S-4	4000	18600	7×10^{-12}
5819	S-9	4800	14900*	2×10^{-11}

† With 100 volts per stage. * With 90 volts per stage.
‡ Measured with 2870°K light source.
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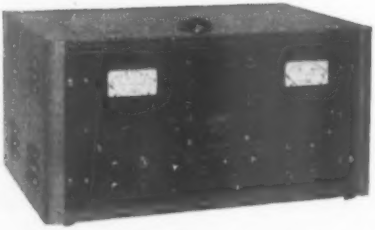

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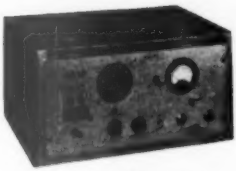

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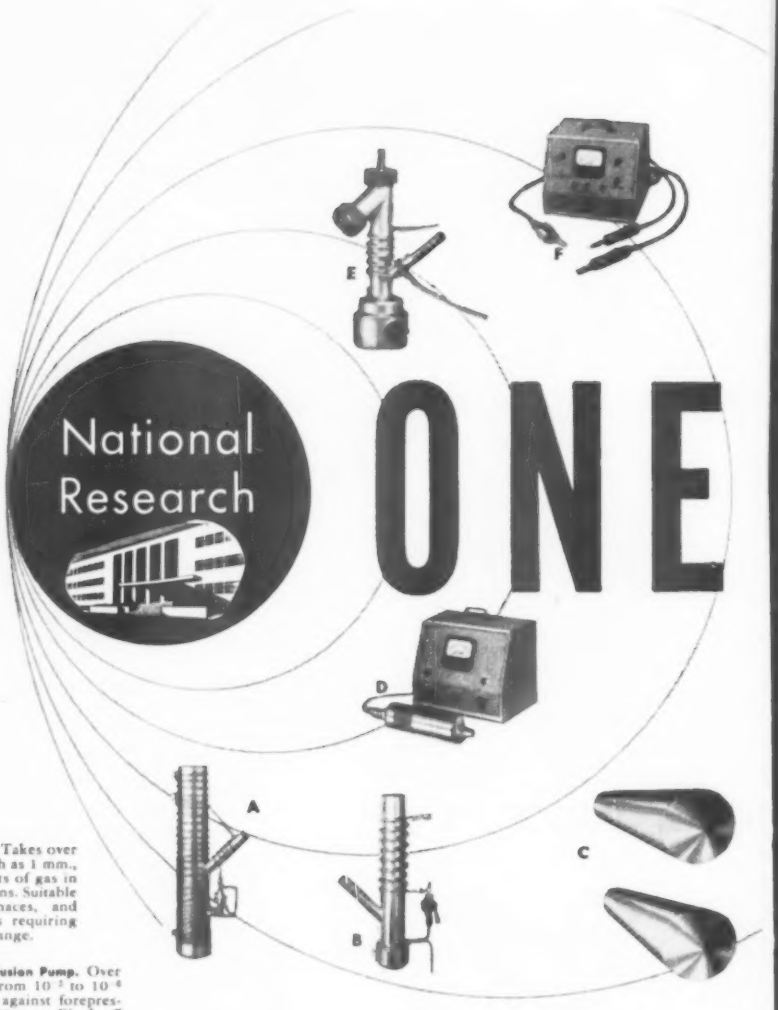

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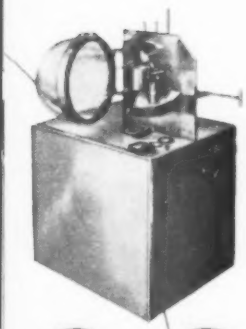

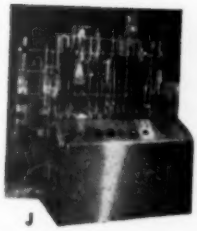

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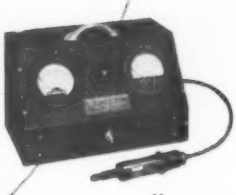

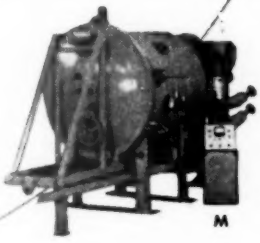

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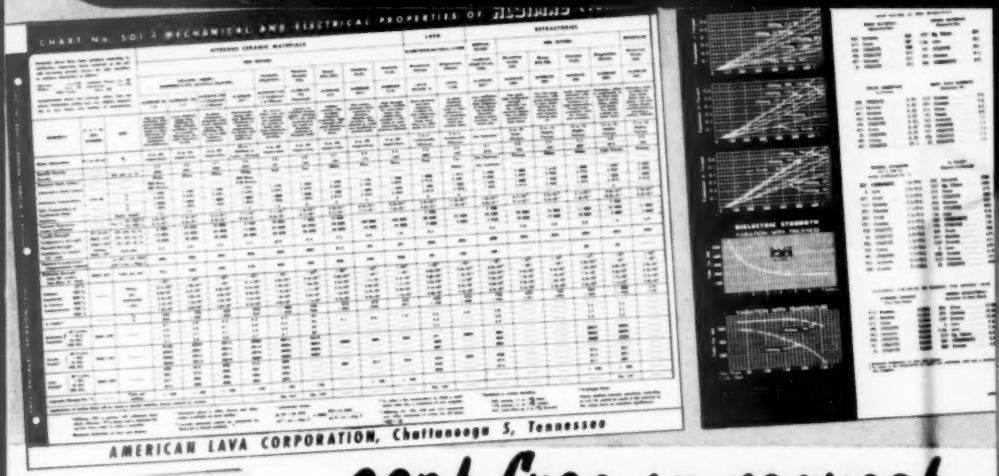

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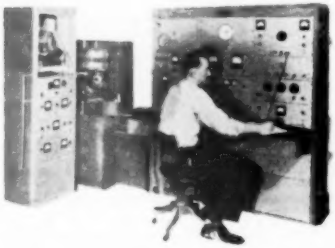

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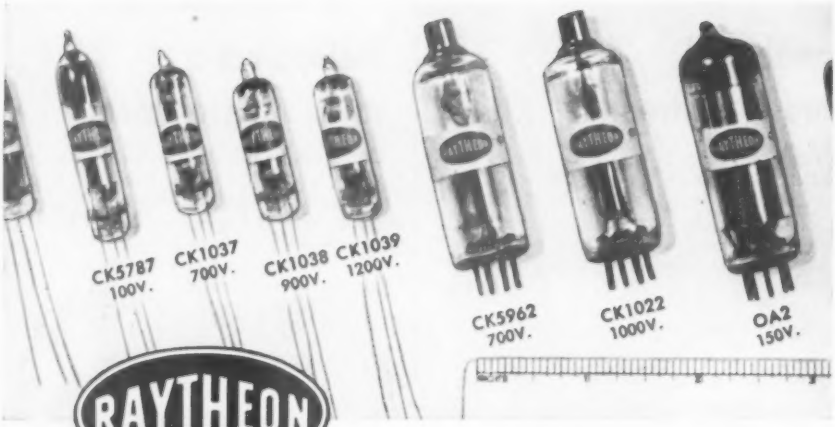

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	HEIGHT	DIAM.					
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OA3/VR75	4.13	1.56	105	75	5	40	5
OB2	2.63	.75	133	108	5	30	4
OB3/VR90	4.13	1.56	125	90	10	30	8
OC3/VR105	4.13	1.56	133	105	5	40	4
OD3/VR150	4.13	1.56	185	150	5	40	5.5
CK1017	2.69	.75	800	700	.005	.055	20
CK1022	2.69	.75	1100	1000	.005	.055	20
CK1037	1.75	.40	720	700	.005	.100	15
CK1038	1.75	.40	925	900	.005	.055	15
CK1039	1.75	.40	1230	1200	.005	.100	25
CK5651*	2.13	.75	115	87	1.5	3.5	3
CK5783*	1.63	.40	115	87	1.5	3.5	3
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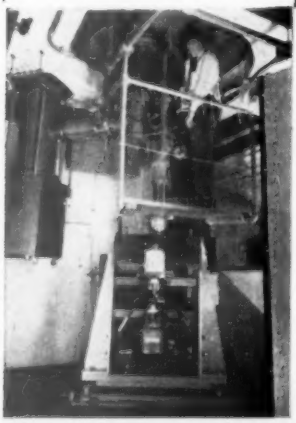

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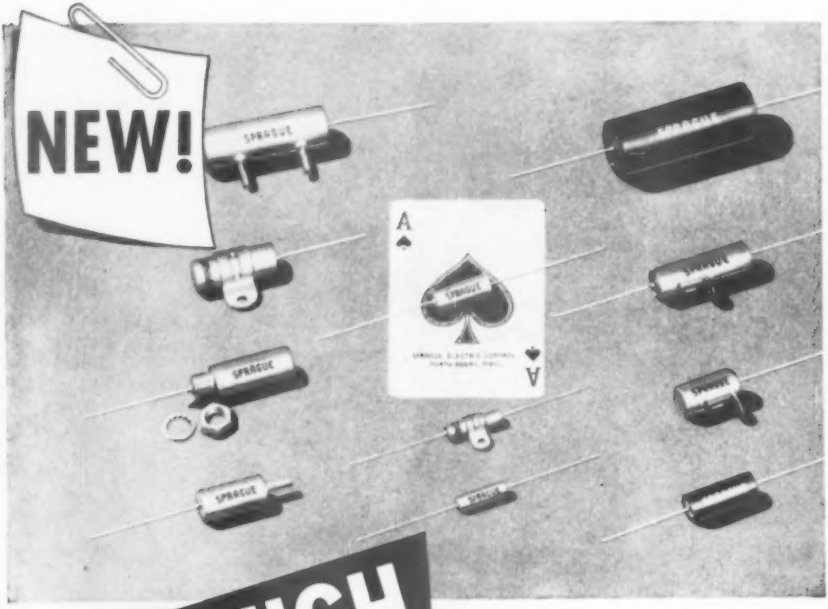

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And they're now available as standard in a 125° C. temperature rating Vitamin Q® capacitor series. Voltage ratings range from 100 to 1000 volts in both inserted tab and extended foil constructions.

And remember, Sprague Capacitors are the standard of dependability for critical electronic circuits. Write for your copy of Bulletin 213-B which gives the complete Sprague Subminiature Story

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- Qualification testing against military specifications.
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NOW AVAILABLE! "ARCHER CLOTH GOWN"

At long last, the much discussed garment of spun lead glass fabric is here! Developed by Dr. V. W. Archer and associates, of the University of Virginia Hospital, it is designed to protect all vulnerable parts of the body from x-radiation and is highly resistant to beta radiation of atomic fission products. No longer do radiologists have to depend entirely upon lead rubber aprons . . . and risk exposure of arms, shoulders and lower legs to scattered radiation.

ADVANTAGES OF LEAD GLASS FABRIC

- Effective in light weights!
- Flexible! • Strong!
- Chemically resistant!
- Non-deteriorating in storage!
- Non-shrinking! • Non-allergic!
- Fireproof!

AVAILABLE IN

- Single layer gown
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- Patch over mid-body *(24 inches high)*
- Apron
- Yard goods for research. curtains, skin protection for superficial therapy, etc.

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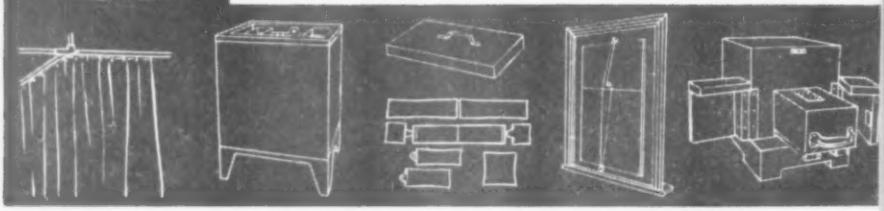
Exclusive license for fabrication and distribution of lead glass material has been granted:

BAR-RAY PRODUCTS, INC.



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RADIATION PROTECTION

FOR MORE THAN A SCORE OF YEARS, Bar-Ray has pioneered in research, development and fabrication of material and equipment for every conceivable phase of radiation protection. Its record of achievement in this vital field embraces such outstanding contributions as the supply of materials to the first atomic bomb explosion at Los Alamos . . . the Veteran Administration's "Thru-the-Wall" Tanks . . . Bureau of Standards Ionization Chamber . . . U. S. Public Health Sensitometric Tank . . . Battlefield processing equipment . . . Isotope conveyor equipment . . . present day installations at Brookhaven National Laboratory.

Radiologists, technicians, research laboratories and industry generally, look to Bar-Ray design and engineering "know-how" to meet and solve specific problems.

Whether your needs are for a tiny lead-headed nail, a two inch lead-lined door or for the installation of a complete radioisotope laboratory, your inquiry will receive prompt and intelligent attention.

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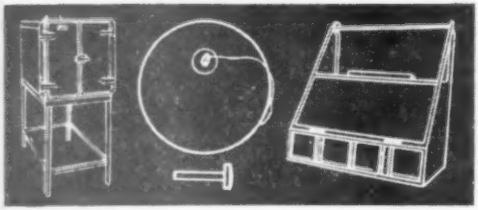

Kindly send prices on: Single layer gown ☐
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Aluminum SMOKE RINGS.....

Type EMD-2 complete with optical system, power supplies, vacuum system, and control panel.

A diffraction pattern of metallic aluminum by

The RCA Electron Diffraction Unit, Type EMD-2!

THIS PATTERN reveals fundamental facts about the crystalline structure of an ultra-thin film of aluminum. The pattern was produced in an RCA Electron Diffraction Unit by bombarding the specimen with a beam of electrons—then capturing the diffraction pattern with a built-in camera.

This instrument is unsurpassed for producing reflection and transmission diffraction patterns from micro-quantities of materials, surfaces, and monomolecular layers. Type EMD-2 makes it possible to distinguish between structures, or forms of materials, which have the same chemical composition but differ physically. In a matter of seconds it can produce clear, brilliant patterns of matter present in quantities too minute for X-ray diffraction. *It is the only means known for examining the atomic structure of true surfaces.*

Type EMD-2 is effective in work with metals, ceramics, plastics, organic films, biologicals, etc. Its usefulness for investigating corrosion, catalysts, lubricants, surface deposits, graphites, and pigments is well established.

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For complete data, write Department 86-W, RCA Engineering Products, Camden, New Jersey.

RCA

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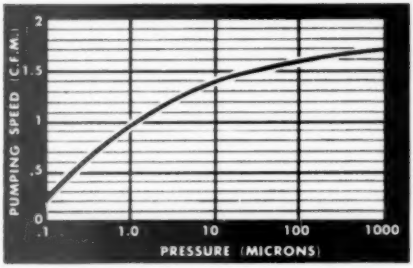
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

THERE'S A LOT OF VACUUM IN THIS LITTLE PUMP!

Look at Kinney Vacuum Pump Model CVM 3153. It's small, yes — only about a foot high. It weighs only 70 lbs. complete with its ¼ HP motor.

Now take a look at its performance curve. See how it starts out with a free air displacement of 2 cu. ft. per min. See how large a percentage of its vacuum "pulling-power" is retained right down to the less-than-1 micron zone.



This is what you buy when you get a Kinney Model CVM 3153 — HIGH PUMPING SPEED. And this is why so many laboratories, so many production operations, so many vacuum service and test jobs are depending on this new Kinney Vacuum Pump. Send coupon for complete details and price. KINNEY MANUFACTURING CO., Boston 30, Mass. Representatives in New York, Chicago, Cleveland, Philadelphia, Los Angeles, Houston, New Orleans, San Francisco, Seattle, and foreign countries.

Kinney
VACUUM PUMPS

KINNEY MANUFACTURING CO.
3614 Washington St., Boston 30, Mass.

Gentlemen:
Please send me Bulletin V51-A describing the new Kinney CVM 3153 Midget Vacuum Pump and price information.

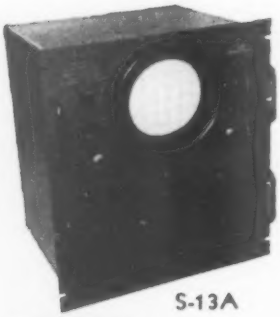
Name .....

Company .....

Address .....

City ..... State .....

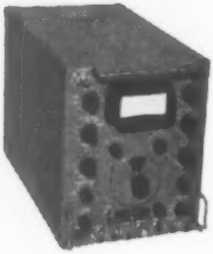
the WATERMAN LINE-UP



S-13A

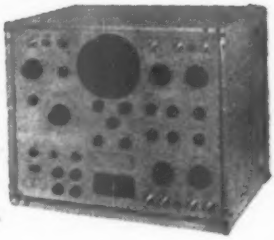
RAKSCOPES

S-12B



S-4A

PULSESCOPES



S-5A

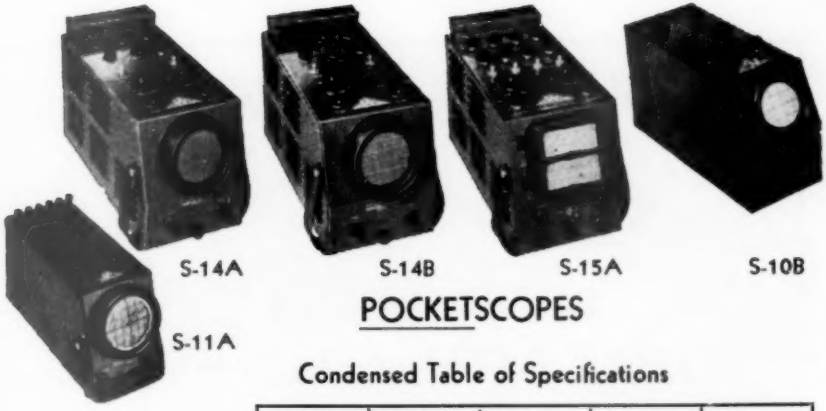
Condensed Table of Specifications

		S-4A	S-5A	S-12B	S-13A
CR Tube	QTY & TYPE	1—3KP1	1—3JP1	1—3RP1	1—7GP4
	VOLTAGE	1000	3000	920	3000
Scope	CHANNELS & TYPE	1—AC	1—AC	1—AC-DC	1—AC-DC
	MARKERS μS	10 and 50	.2 to 500	.....	.....
	CALIBRATION	YES	YES	.....	.....
Vertical Response	MAX. RMS V/IN	.24	0.04	0.05	0.05
	SINE CPS — 2BD	2—8.5 MC	6—7 MC	0—200 KC	0—600 KC
	PULSE RISE μS	0.035	0.045	1	0.4
Horizontal Response	MAX. RMS V/IN	.....	3	0.05	0.05
	SINE CPS — 2DB	.....	2—700 KC	0—200 KC	0—600 KC
	PULSE RISE μS	.....	0.5	1	0.4
Linear Time Base	RANGE IN CPS	80—800 KC	8—800 KC	5—50 KC	0.5—50 KC
	TYPE	REP—TR—A—R	REP—TR	REP—TR	REP—TR
Case	SIZE (APPROX.)	17x9x11	13x16x14	9x19x7	14x19x21
	WEIGHT	31.5	60	30	110
Power	INPUT—WATTS	150	215	80	330

For Further Information Write to

WATERMAN PRODUCTS CO., INC.

PHILADELPHIA 25, PA., U. S. A.



S-14A S-14B S-15A S-10B

S-11A

POCKETSCOPES

Condensed Table of Specifications

		S-10B	S-11A	S-14A	S-14B	S-15A
CR Tube	QTY & TYPE	1—2AP1	1—3MP1	1—3RP1	1—3RP1	2—3SP1
	VOLTAGE	350	560	900	900	900
Scope	CHANNELS & TYPE	1—AC	1—AC-DC	1—AC-DC	1—AC-DC	2—DC
	MARKERS μS	.....	.....	.....	.....	.....
	CALIBRATION	.....	.....	YES	YES	YES
Vertical Pressure	MAX. RMS V/IN	1.0	.1	0.01	0.05	0.01
	SINE CPS —2DB	20—150 KC	0—200 KC	0—180 KC	0—700 KC	0—180 KC
	PULSE RISE μS	.....	2	1.8	0.35	1.8
Horizontal Response	MAX. RMS V/IN	1.0	0.1	0.015	0.15	1.0
	SINE CPS —2DB	20—150 KC	0—200 KC	0—180 KC	0—200 KC	0—150 KC
	PULSE RISE μS	.....	2	1.8	1.8	3
Linear Time Base	RANGE IN CPS	10—50 KC	3—50 KC	0.5—50 KC	0.5—50 KC	0.5—50 KC
	TYPE	REP	REP	REP—TR	REP—TR	REP—TR
Case	SIZE (APPROX.)	10x4x6	11x5x7	12x6x7	12x6x7	12x6x7
	WEIGHT	5	8¾	12¾	14	16¼
Power	INPUT—WATTS	23	43	50	70	75

RAYONIC C-R TUBES (Available in P1-P2-P7-P11 Phosphor)

3 SP

TUBE	TYPICAL OPERATION						
	VOLTS			V/IN		MAX. VOLT	
	ANODE #2	ANODE #1	GRID #1	D1, D2	D3, D4	ANODE #2	ANODE #1
3SP	1000	165 to 310	−28 to −67	73 to 99	52 to 70	2750	1100
	2000	330 to 620	−58 to −135	146 to 198	104 to 140		
3MP	1000	200 to 350	0 to −68	140 to 190	130 to 180	2500	1000
	2000	400 to 700	0 to −126	280 to 380	260 to 360		

3 MP

For Both Tubes—Heater Voltage...6.3 Heater Current...6 amps.

AN ISOTRONIC* FIRST

*Isotronics is a trade marked word pertaining to the electronic regulation and control of voltage, current, power, or frequency.

±0.01% AC Regulation!

That's the degree of accuracy attained by Sorensen's new Model 1001 AC Line Voltage Regulator!

Heretofore, the closest regulation in commercially available regulators has been ±0.1%, regardless of manufacturer or circuit approach. Now, Sorensen's continuing study and design refinements have produced a super-accurate regulator — the Model 1001 — as a *standard* catalog item.

GENERAL SPECIFICATIONS	
Load range	0 — 1000 VA
Input voltage range	95 — 130 VAC, 1ϕ, 55 — 65~
Load P. F. range	0.7 lagging to 0.95 leading
Output voltage	115 VAC, 1ϕ (adjustable from 110-120 volts)
Distortion	3% max.
Time constant	0.1 seconds
Regulation accuracy	±0.01%

The accuracy is *guaranteed* at room temperature, for a resistive load, an input variation of ±10%, and over a two-to-one load change. For *all* other conditions within the specifications, the Model 1001 has a proportionate amount of accommodation.

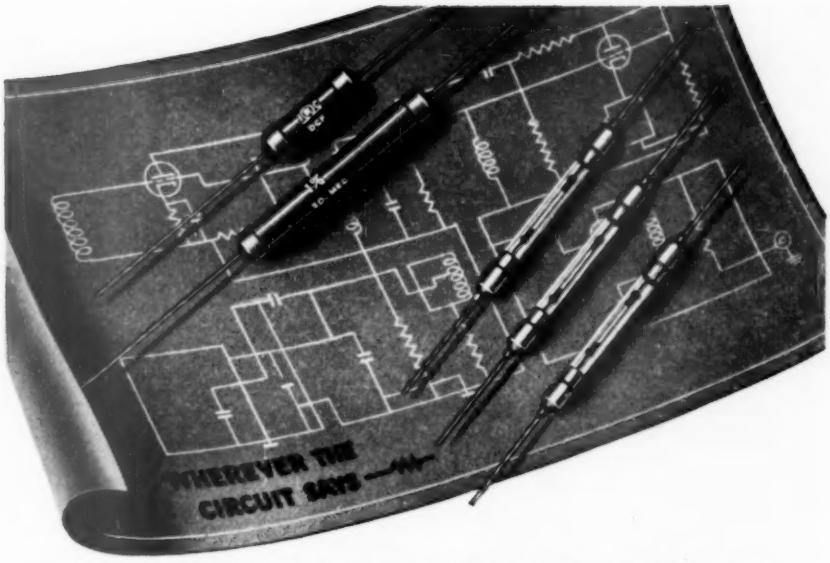
NOTE THESE EXTRA FEATURES

- **Combination twist-lock and double-T receptacle, or, output terminals to eliminate contact resistance.**
- **Three-function output switch for**
  1. **Normal regulator functioning.**
  2. **Operation with integral semi-fixed resistance in place of potentiometer.**
  3. **Direct load connection with the control diode for regulation of voltages other than 115 volts.**
- **Only FOUR vacuum tubes and NO relays are used.**
- **All tube filament voltages are regulated for long dependable life.**

Write for full information

Specify SORENSEN

375 FAIRFIELD AVENUE • STAMFORD, CONNECTICUT



RESISTANCE AS HIGH AS YOU NEED IT!

New IRC Type UHR (Ultra High Resistance) Resistors actually provide resistance values of 10^8 to 10^{12} ohms inclusive! High resistance and small size make them suitable for use in such critical applications as atomic research instrumentation. Hermetically sealed in inert gas in glass tubes, the new UHR's are protected from mechanical damage and exposure to atmospheric conditions. Tolerances:— ±10% standard, ±5% and labeled to within ±1% of actual value at additional cost.

IRC Deposited Carbon PRECISTORS—within limits of 200 ohms to 5 megohms, and 500 ohms to 20 megohms—are manufactured to customers' exact specifications, rather than to standard RMA values. Above-standard ranges, of course, can be made to special order. Made of pure crystalline carbon bonded to selected ceramic cores, PRECISTORS are unusually well-suited to high frequency requirements, electronic computers, and as replacements in all kinds of test equipment. We recommend them particularly for circuits where carbon compositions are unsuitable and wire-wound precisions too expensive.

Send for free Technical Data Bulletins on these IRC Resistors—and be sure to ask about our Industrial Service Plan. It enables your IRC Distributor to give you prompt delivery of maintenance and experimental quantities—right from his local stocks. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa. In Canada: International Resistance Co., Ltd., Toronto, Licensee.

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Power Resistors
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Please send me additional information on items checked below:—

☐ Deposited Carbon PRECISTORS
☐ New UHR Resistors ☐ Name of local IRC Distributor

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Leitz MICRO OPTICS for NUCLEAR TRACK WORK

A new series of objectives and eyepieces designed especially for observation of cosmic ray "events" on nuclear tracks. Particularly recommended for use with the Leitz "Ortholux" and Type "B" Binocular Microscopes, and may be used on other standard types of microscopes.

Achromatic Objective 10:1, N.A. 0.25, No. 3; for the general survey of track plates with emulsions of any thickness..... **$17.50**

Achromatic Objective 25:1, N.A. 0.50, No. 4b; for the examination of nuclear track plates of any thickness..... **29.00**

Achromatic Oil Immersion Objective 22:1, N.A. 0.65, 8mm., Oil-W; for the examination of nuclear track plates, of all thicknesses, which are covered with oil..... **48.50**

Achromatic Objective Ks, 45:1, N.A. 0.65, for emulsion thicknesses from 0 to 100 microns; for examination of nuclear track plates which have an emulsion thickness from 100 to 200 microns and the thickness of which is between 50 to 100 microns after fixing..... **46.00**

Fluorite Oil Immersion Ks, FL Oil, 53:1, N.A. 0.95, for emulsion thicknesses from 0 to 1000 microns; for the examination of nuclear track plates up to 2mm. in thickness which remain, after fixing, at a thickness of approximately 1mm. Particularly recommended for the counting of grains and the measurement of track tracings on plates which are 370 microns thick after fixing.. **91.00**

Apochromatic Objective, Ks, Apo Oil, 100:1, N.A. 1.32, for emulsion thicknesses from 0 to 370 microns; for grain counts and the measurement of track tracings on plates up to 600 microns which remain, after fixing, at a thickness of 370 microns. This lens is used, in connection with Periplan eyepiece 25x, to determine, at minimum depth of field, the relative position of two track grains in contact with one another..... **190.00**

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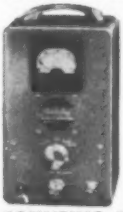
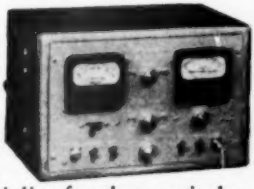
For Your Nuclear Laboratory

BASIC SCALER Model 100 was designed for the express purpose of providing an easy-to-operate scaling circuit of the *finest quality* at *minimum cost*, and in such form that additional facilities could be added from time to time to meet the increasing requirements of the user. In one compact unit this instrument combines a *direct reading electronic scale of 100*, mechanical register for *extended range* and a *regulated high voltage power supply*. An *accessory socket* permits full use of such auxiliary equipment as automatic clock, predetermined timers, extended range unit for predetermined count, loud speaker, count rate meter and count rate computer. Dimensions: 14½" x 9¾" x 10¾". Wt. 18 lbs.

UTILITY SCALER Model 110 includes all of the features of the Model 100 plus additional facilities which make it a universal laboratory instrument for nuclear work. The power supply can, by simple adjustment, be made to provide either *positive* or *negative high voltage*, thus making it suitable for use with either *Greiger Muller or Scintillation detectors*. A built-in preset-count mechanism provides scaling factors of 100, 200 and 400 and *automatic predetermined counts* of 1000, 2000, 4000, 10,000 and 20,000. *Accessory plug* and convenience outlet at the rear chassis of the Scaler which provide for unit, counting rate computer, preamplifier and other auxiliary devices. Dimensions: 14½" x 9¾" x 10¾". Weight: 18 lbs.



LABORATORY MONITOR Model 1800 is a general purpose count rate meter with provision for *visual and aural indication*. Panel switch permits selection of five different meter ranges (300 cpm., 900 cpm., 3000 cpm., 30,000 cpm.) Meter is *self zeroing* and does not require calibration. A single control is provided for "On-Off" and volume control of aural section. Monitor is supplied complete with GM tube and probe. Dimensions: 6½" x 6½" x 10½". Weight: 8 pounds.



COUNTING RATE METER Model 1810, is a complete general purpose laboratory instrument, with provision for panel switch selection of *10 different counting rate ranges* and 8 *different response half-time factors*. For each position of the "Range" switch both range in counts per minute and the deviation in counts per minute may be *read directly* on the instrument panel. For each position of the "Response ½-time" switch both response half-time in seconds and the deviation multiplier for that particular response time may be *read directly* on the instrument panel. Thus it is possible to *select* absolute *optimum operating conditions* for any given circumstance. A zero meter check and a 7200 count per minute calibration are also provided. Unit includes regulated high voltage and low voltage supplies. Dimensions: 14½" x 9¾" x 10¾". Weight: 20 pounds.

For data sheets and prices, please write Dep't. N

Berkeley Scientific Corporation

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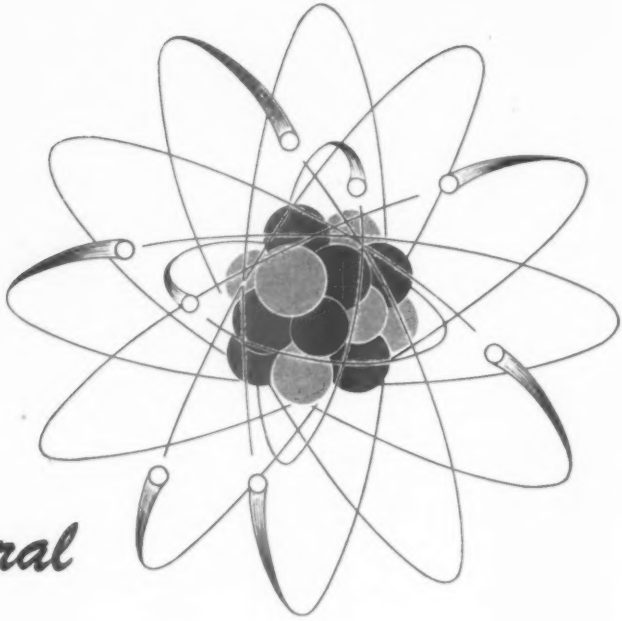

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ELDORADO MINING AND REFINING (1944) LIMITED

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VOLTAGE REGULATED POWER SUPPLIES

For Industrial and Research Use

MODEL 1220
OUTPUT DC: 0-1200 volts, 20 Ma.
OUTPUT AC: 6.3 volts, 10 Amp., CT.

DC POWER SUPPLY SPECIFICATIONS

REGULATION: ½% for both line (105-125 volts) and load variations.
REGULATION BIAS SUPPLIES: 10 millivolts for line 105-125 volts.
½% for load at 150 volts.
RIPPLE: 5 millivolts RMS.

VOLTS	CURRENT	MODEL
100-325 0-150 Bias 6.3 AC.CT.	0-150 Ma. 0-5 Ma. 10 Amp.	131
200-500 6.3 AC.CT.	0-200 Ma. 6 Amp.	245
0-300 0-150 Bias 6.3 AC.CT.	0-150 Ma. 0-5 Ma. 5 Amp.	315
0-500 6.3 AC.CT.	0-300 Ma. 10 Amp.	500R
#1 200-500 #2 200-500 #3 6.3 AC.CT. #4 6.3 AC.CT.	0-200 Ma. 0-200 Ma. 6 Amp. 6 Amp.	510
0-500 0-150 Bias 6.3 AC.CT.	0-200 Ma. 0-5 Ma. 10 Amp.	515
#1 0-500 #2 0-500 #3 6.3 AC.CT. #4 6.3 AC.CT.	0-200 Ma. 0-200 Ma. 10 Amp. 10 Amp.	600

VOLTS	CURRENT	MODEL
0-500 0-150 Bias 6.3 AC.CT.	0-300 Ma. 0-5 Ma. 10 Amp.	615
#1 0-600 #2 0-600 #3 6.3 AC.CT. #4 6.3 AC.CT.	0-200 Ma. 0-200 Ma. 10 Amp. 10 Amp.	800
0-600 0-150 Bias 6.3 AC.CT.	0-200 Ma. 0-5 Ma. 10 Amp.	815
0-1000-Ripple 10 mv. 6.3 AC.CT.	0-20 Ma. 10 Amp.	1020
0-1200-Ripple 10 mv. 6.3 AC.CT.	0-20 Ma. 10 Amp.	1220
200-1000-Ripple 20 mv.	0-500 Ma.	1250
0-1000-Ripple 20 mv.	0-500 Ma.	1350
Specify your voltage and current requirements. Regulation available .5%, .1%, .01%.		SPECIAL SERIES

*All AC Voltages are unregulated. All units are metered except Models 131 and 315.

All units designed for relay rack mounting or bench use.

The Kepco Voltage Regulated Power Supplies are conservatively rated. The regulation specified for each unit is available under all line and load conditions, within the range of the instrument. Write for specifications.

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ENARDE

NEW LOW - TEMPERATURE FILLING

G-M COUNTER TUBES

DIMENSIONS IN MILLIMETRES					AVERAGE CHARACTERISTICS			
Type	*Description*	*Overall Length*	*Maximum Outside Diameter*	*Effective Anode Length*	*Operating Voltage*	*Plateau Length (volts)*	*Plateau Slope %/volt*	*Shielded Background cpm.*
GTX-1	X-ray Diffraction Counter	160	25	100	1100	200	0.05	30
GT-10	Immersion or General Beta Counter	142	18	60	1100	220	0.06	13
GT-11	Immersion or General Beta Counter	202	18	120	1100	220	0.05	26
MRC-1	Powder or Liquid Beta Counter	190	24	60	1100	220	0.06	11
MRC-2	Powder or Liquid Beta Counter	250	24	120	1100	220	0.05	22
GT-21	Gamma Counter	310	38	220	1100	220	0.05	80

WITH MATCHED

CORONA STABILISER

VOLTAGE REGULATOR

The use of matched Corona Stabilisers provides ideal counting conditions and ensures longer life to any Geiger counter tube.

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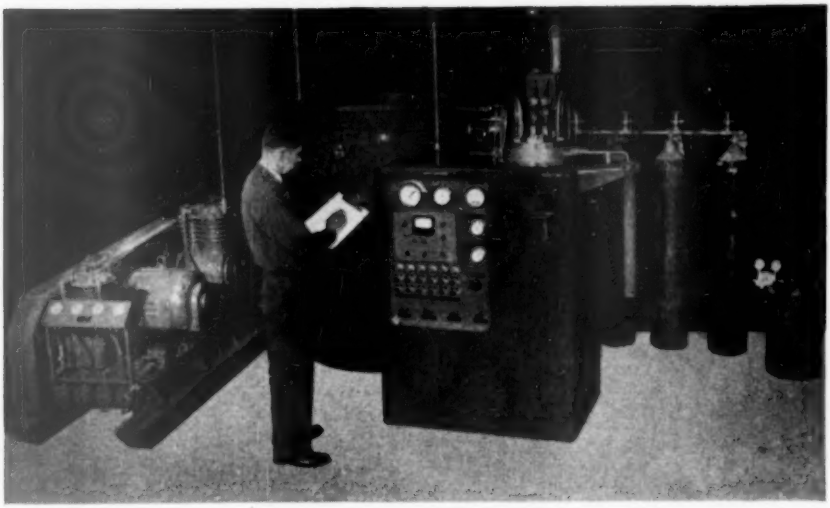

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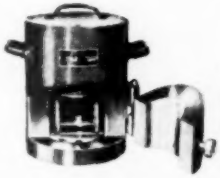

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The "100" Scaler is a direct reading "conventional" scaler which indicates the number of counts received during an arbitrary length of time. It utilizes two SC-11 Decasale plug-in units based on four cascaded scales of two with two feedback loops to provide a scale of ten. A Wizard Register capable of recording up to 600 evenly spaced counts per minute, makes it possible to count as many as 60,000 evenly spaced impulses per minute. The start-stop switch will also actuate a separate clock such as the SM-60A Electric Timing Clock.

The instrument has been designed to require a minimum of service, with all components overdesigned so that every part is rated for service in excess of that required for normal usage. *For further information, request bulletin NX-38.*

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Current output—1 milliampere
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Dimensions—5¼" x 4½" x 5"

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Dimensions of HV unit—14" x 11" x 12". Separate low voltage DC Supply—14" x 6" x 8".

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VARIABLE 20-40 KV RF TYPE DC POWER SUPPLY
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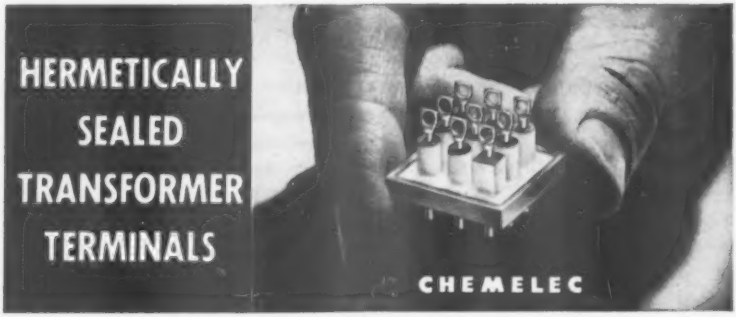

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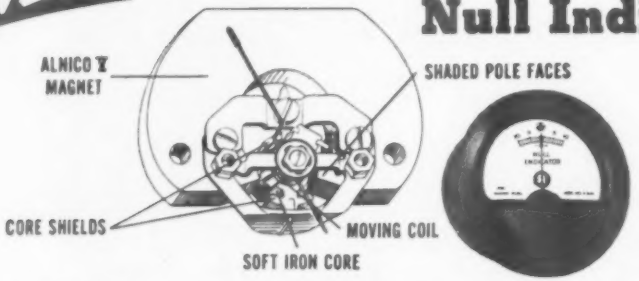

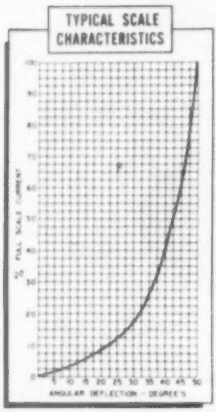

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Begins on page C-1 of this issue

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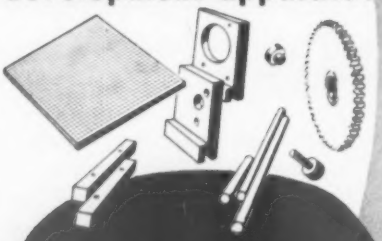

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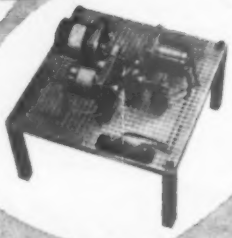

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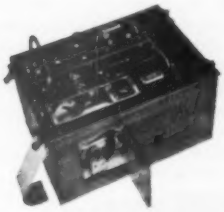

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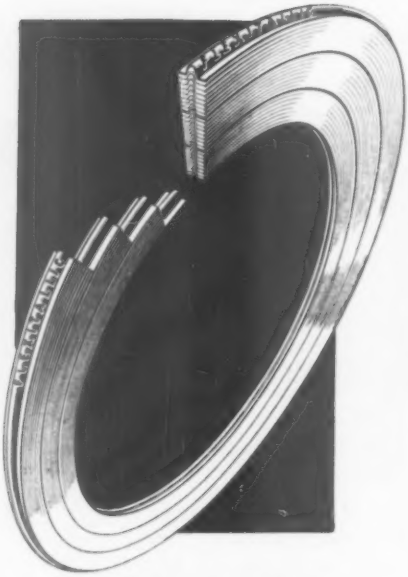

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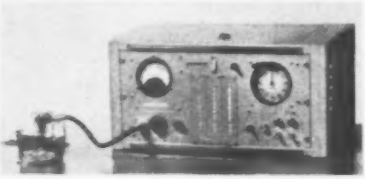

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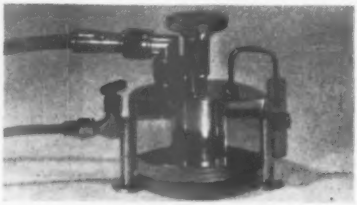

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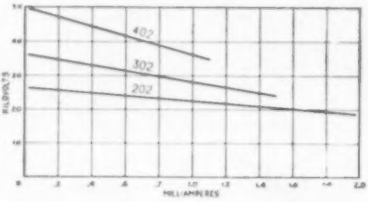

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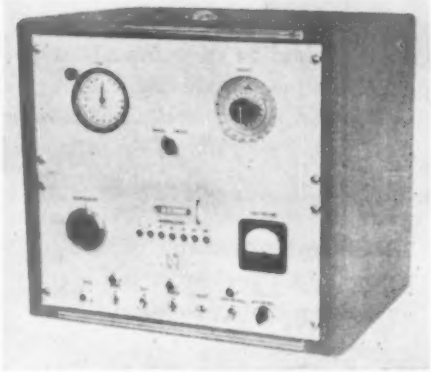

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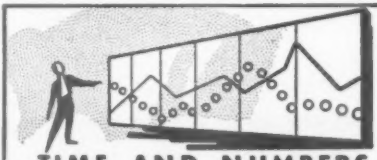

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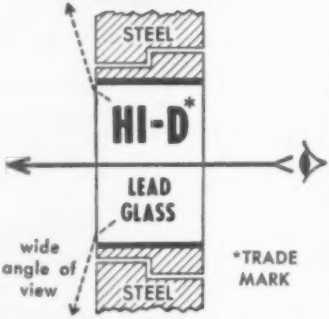

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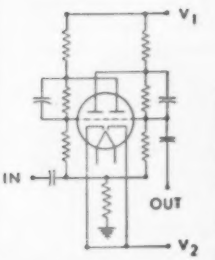

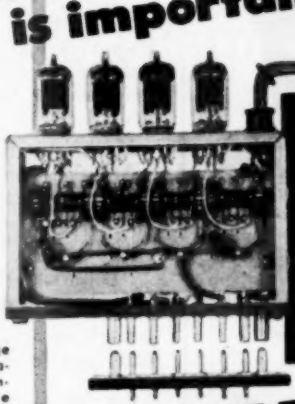

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In this special section, we have for the first time collected data that is of primary interest to nucleonics personnel working for, or as consultants to, civil-defense agencies.

The following are included here:

Fission-Product Decay Rates C-2
Slow-Neutron-Induced Activities C-8
Dosage Calculator C-10
Decontamination Chart C-12
Survey Meters for Water Monitoring C-16

This is definitive information about the radiation aspects of civil defense. It is the result of research carried out by scientists directly concerned with these problems.

Fission-Product Decay Rates

H. F. HUNTER and N. E. BALLOU

U. S. Naval Radiological Defense Laboratory
San Francisco, California

SEVERAL MEASUREMENTS have been made in recent years of the total beta and gamma radiation emitted by fission products at various times after fission. A summary of the results of these measurements has been presented by K. Way and E. P. Wigner (*1*), who have also estimated the beta emission theoretically. The experimental measurements have all applied to various positive lengths of time of irradiation of U^{235} with slow neutrons.

The present calculations concern a process in which a number of U^{235} atoms all undergo fission simultaneously. The decay rates $A_x(t)$ for each fission product x at time t after slow-neutron fission of 10,000 atoms of U^{235} were computed in terms of the experimentally determined values of half-lives and fission yields. The decay curve of the fission-product aggregate and the relative contributions of individual nuclides and of elements at various times to the total activity were calculated from the basic $A_x(t)$ data.

Discussion

The decay rates of each member of all known fission-product radioactive chains were calculated for 28 different times after fission by applying the well-known equations for radioactive decay (*2*). The values of the half-lives of the fission products were taken from the Plutonium Project compilation (*3*) with the exceptions that, where corrected values of half-lives have been published and where new fission-product radionuclides have been discovered, the more recent data (*4*) have been used. In the cases in which only upper limits or qualitative statements were reported, very rough estimates of half-lives were made for these computations.

In addition to half-lives, fission yield values are also necessary in calculating relative levels of radioactivity of each of the fission products. Chain fission yields were taken from the Plutonium Project compilation (*3*). Independent fission yields were calculated according to the postulate of equal charge displacement (*5*). This states that the most probable mode of charge division is that which leads to equal charge displacements, i.e., equal effective chain lengths, or $Z_A - Z_p$ values, for the two primary fission products; Z_A is the hypothetical, most stable charge (*6*) (nonintegral) for a given mass number, A, and Z_p is the most probable charge of a primary fission fragment. It is not known whether or not the postulate of equal charge displacement quantitatively gives the relative independent yields for all fission-product nuclides. It is used in these calculations because it fits the limited amount of experimental data available as well as or better than any other postulate.

In some chains branching occurs, i.e., part of the chain decays go by way of one isomer of a given nucleus and the rest go by way of a second isomer of the same nucleus. Knowledge of the fraction of the chain decays going through each branch was necessary for these calculations. In the cases where these data were not reported (*3*), they were

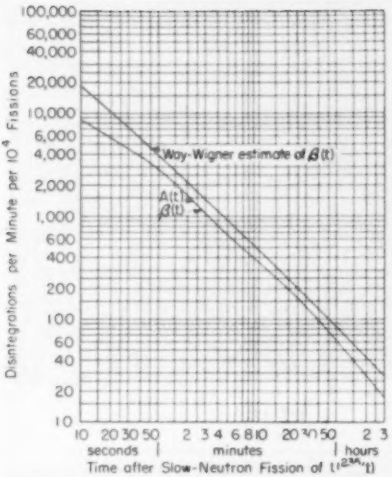


FIG. 1. Decay curves for gross fission products

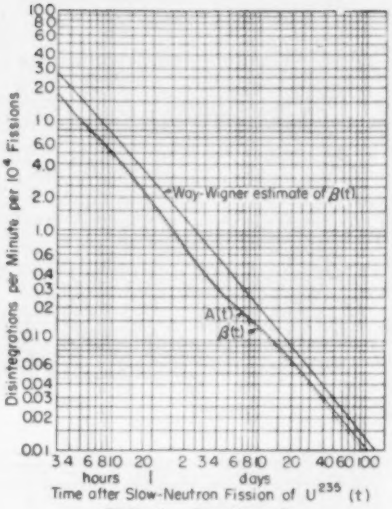


FIG. 1. Continued

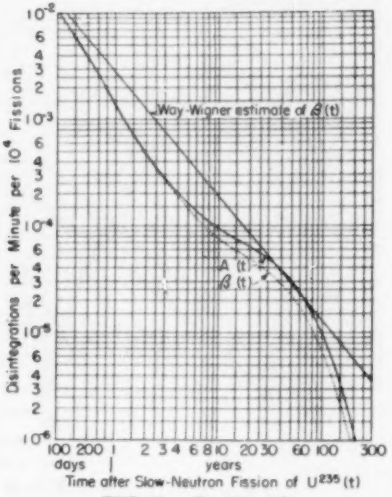


FIG. 1. Continued

computed from the observed fission yield of one member of the branch and the chain fission yield as read from the smoothed curve of chain yield versus mass number curve (*3*). Branching ratios were calculated for the delayed-neutron emitters by using their reported relative yields (*7*).

Results

The results of these computations are summarized in Figs. 1, 2, and 3. The computed gross decay curve, the computed gross beta-decay curve, and the gross beta-decay curve as given by Way and Wigner (*1*) are given in Fig. 1. The relative contributions of fission-product radionuclides to the total activity as a function of time are given in Fig. 2. The relative contributions of fission-product elements to the total activity as a function of time are given in Fig. 3.

The main source of error in the results is the discrepancy between the present experimental picture of the fission products and the true picture. This discrepancy is greatest for short times for two reasons: (1) the half-lives and yields of many short-lived nuclides are not yet known and had to be estimated here, and (2) there undoubtedly exist very-short-lived nuclides as yet undetected.

The form of the relative independent yield curve used (*5*) directly affects the calculated amount of radioactivity asso-

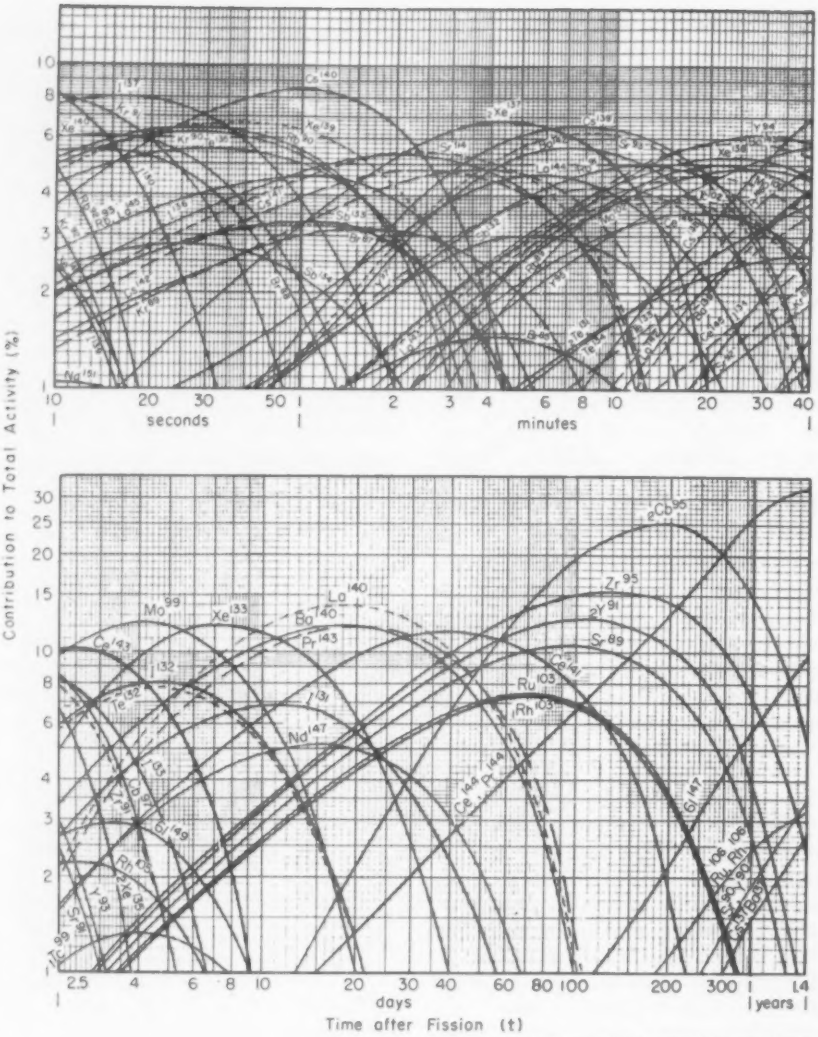
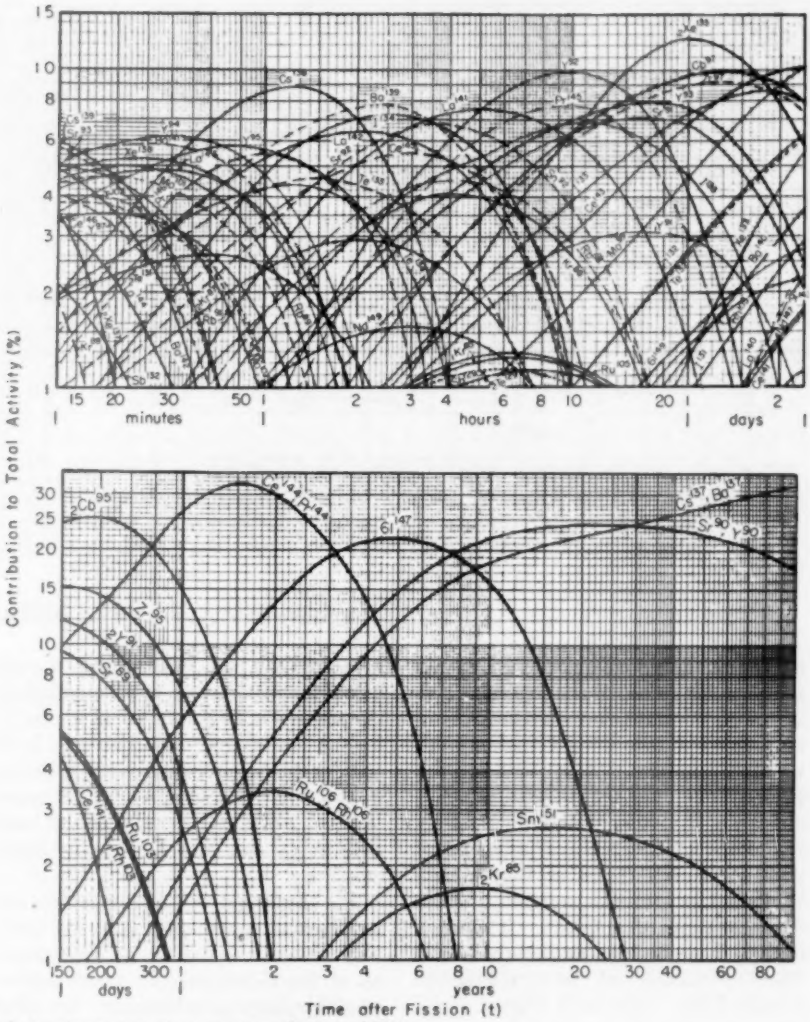


FIG. 2. Relative activities of the nuclide products

ciated with each radionuclide formed in the fission process. The chain members affected the most are those several decay steps removed from stability; the computed radioactivities of the last active members are usually little influenced by the form of the curve. This is due to the fact that relative independent yields of the latter are probably quite small and thus nearly all of them are formed by radioactive decay of preceding chain members. The results as shown in Figs. 2 and 3 for the relative contributions to the total activity by individual radionuclides and by elements are consequently more dependent



of simultaneous slow-neutron fission of U^{235}

on values of the independent yields taken than are the results shown in Fig. 1 for the gross decay curve. Only for moderately short times after fission is the effect of the choice of values of relative independent yields of significance. This is because, as indicated above, radionuclides having large independent yields probably are several active members away from stability and, thus, have moderately short half-lives.

At short times after fission, the gross activities, $A(t)$, obtained in these computations are probably smaller than the correct values, and the gross decay

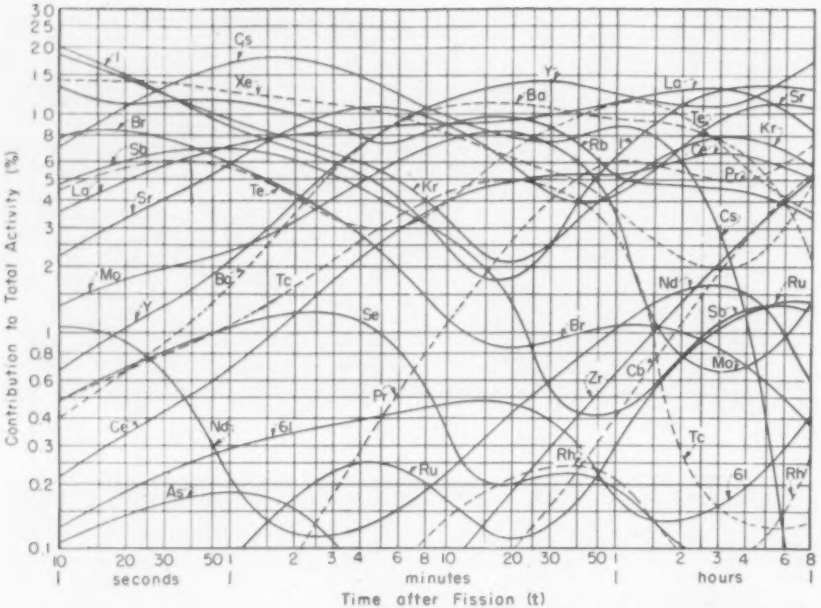
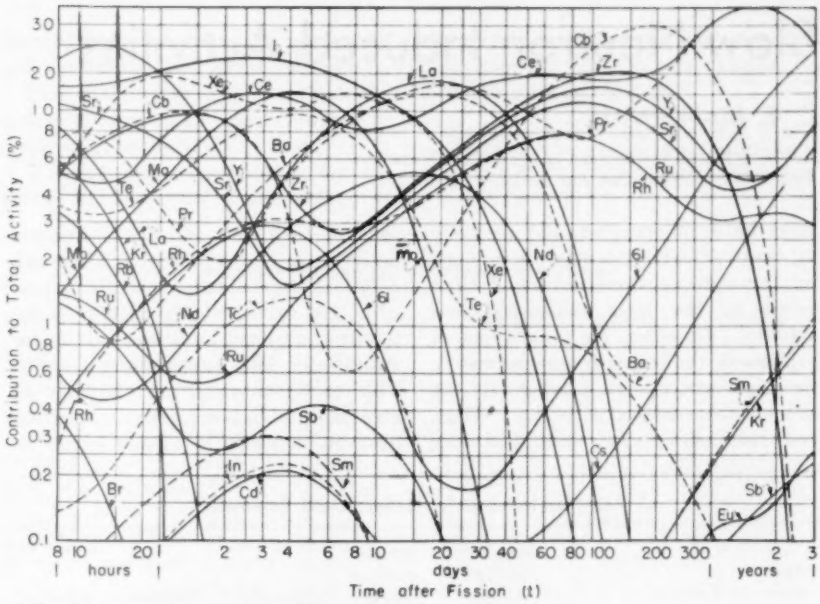


FIG. 3. Relative activities of element products

curves given in Fig. 1 are less accurate than the Way and Wigner curve. This is due to the unknown contributions of undiscovered, short-lived fission-product radionuclides. Also, as has been pointed out, the short-lived radionuclides are the ones most influenced by the shape of the relative independent yield curve used; this, therefore, reduces the reliability of the computed curve for short times after fission. The value of $A(0)$ computed in this paper is 43,800 dpm/10^4 fissions and can be considered a lower limit. Way and Wigner give a value of 228,000 dpm/10^4 fissions for $A(0)$. A rough approximation to an upper limit of $A(0)$ can be obtained by using the expression (*8*) for beta emission, $\lambda = kE^5$, where λ is the decay constant, E is the beta energy, and k has a value of about 3×10^{-4} sec^{-1} Mev^{-5}. With the assumption that 2×10^4 beta-unstable fission-product nuclides have a maximum beta energy of 15 Mev (since for energies much greater than this, disintegration will occur by neutron or proton emission) the upper limit of $A(0)$ is calculated to be 2.8×10^8 dpm/10^4 fissions. It is to be emphasized that this is an estimate of the order of magnitude of an upper limit of $A(0)$ and that the actual total activity at zero time is probably much smaller.

For the longer times after fission, the most accurate values of $A(t)$ are probably the calculated ones. Essentially all of the fission-product radionuclides should be known by then, and the effect of the independent yields should be small. As the times after fission become greater, the number of fission-product radionuclides becomes less; this necessarily results in poorer statistics in the Way and Wigner method. For the period of several hours to about one year, it is estimated that the computed values of $A(t)$ are within about 10% of the correct values. At very long times after fission, $A(t)$ depends only on



of simultaneous slow-neutron fission of U^{235}

several radionuclides and so is more sensitive to a change in the experimental value of the half-life of any nuclide than it is when there are more contributors present. The half-lives of such long-lived radionuclides as Cs^{137}, Sr^{90}, Pm^{147}, and Sm^{151} are known less accurately than those of many of the other fission products; as better values of their half-lives are determined, there will be corresponding changes in $A(t)$ which may be appreciable.

Approximate expressions for $A(t)$ in dpm/10^4 fissions have been derived from the computed curve in Fig. 1. They are as follows (t is in minutes):

$$A(t) = 2{,}800\, t^{-0.89} \quad 1 \text{ min} \leq t < 30 \text{ min}$$
$$A(t) = 5{,}700\, t^{-1.11} \quad 30 \text{ min} \leq t < 1 \text{ day}$$
$$A(t) = 15{,}600\, t^{-1.25} \quad 1 \text{ day} \leq t < 4 \text{ days}$$
$$A(t) = 2{,}400\, t^{-1.03} \quad 4 \text{ days} \leq t < 100 \text{ days}$$
$$A(t) = 2.16 \times 10^6\, t^{-1.60} \quad 100 \text{ days} \leq t < 3 \text{ yr}$$

* * *

The authors are very happy to express their gratitude to Dr. W. H. Sullivan for his initiation and continued support of this work.

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Slow-Neutron-Induced Activities

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IT IS USUALLY assumed, and correctly so, that radioactive intensities induced by the slow neutrons are small compared to the total fission-fragment activity. However, for some types of explosions, the fission fragments rise to the upper atmosphere, leaving only the slow-neutron-induced activities. Thus, one must determine what activities must be dealt with, and what maximum activities might be present. These calculations, to evaluate as simply as possible the extent of the slow-neutron-induced activity, have been made for underwater and underground bursts. The results obtained may be used to give the total induced activity resulting from an explosion in various combina-

Activities Induced by Underground Explosion

Isotope produced	*Number of atoms per cm³*	*Half-life*	*Cross section for isotope production (barns)*	*Atomic capture cross section (barns)*	*Activity at t = 0 (curies)*	*Activity at t = 1 hr (curies)*	*Activity at t = 24 hr (curies)*
O^{19}	4.8×10^{22}	31 s	4×10^{-7}	9×10^{-4}	2.1×10^{-5}		
Si^{31}	1.6×10^{23}	170 m	4.9×10^{-2}	0.135	2.9×10^{7}	2.2×10^{7}	5.8×10^{4}
Al^{28}	4.8×10^{21}	2.4 m	0.21	0.21	2.7×10^{9}	4.6	
Fe^{59}	1.4×10^{21}	46.3 d	10^{-2}	2.425	140	140	138
Ca^{45}	1.5×10^{21}	152 d	0.013	0.42	540	540	538
Ca^{49}		2.5 h	3.9×10^{-4}		2.4×10^{4}	1.8×10^{4}	24
Ca^{49m}		30 m	10^{-3}		3.2×10^{5}	8.0×10^{4}	
Na^{24}	2×10^{21}	15 h	0.63	0.63	8.6×10^{6}	8.2×10^{6}	2.6×10^{6}
K^{42}	1.1×10^{21}	12.4 h	0.067	2.05	5.4×10^{5}	5×10^{5}	1.4×10^{5}
Mg^{27}	1.5×10^{21}	10.2 m	5.4×10^{-3}	0.06	5.4×10^{7}	8×10^{5}	
Ti^{51}	2.5×10^{20}	6 m	7.5×10^{-3}	5.85	2×10^{6}	2×10^{3}	
P^{32}	6×10^{19}	14.3 d	0.23	0.23	4.4×10^{3}	4.4×10^{3}	4.1×10^{3}
Mn^{56}	2.4×10^{19}	2.6 h	10.7	10.7	1.1×10^{8}	9.1×10^{7}	1×10^{5}
F^{20}	6×10^{19}	10.4 s	9.4×10^{-3}	9.4×10^{-3}	1.9×10^{7}		
Cl^{36}	1.8×10^{19}	2×10^{6} y	31.9	32	3.6×10^{-3}	3.6×10^{-3}	3.6×10^{-3}
Cl^{38}		38.5 m	0.137		4.0×10^{5}	1.4×10^{5}	4.0×10^{-7}
S^{35}	1.8×10^{19}	87.1 d	0.011	0.5	10.8	10.8	10.72
S^{37}		5.0 m	1.4×10^{-5}		310	7.8×10^{-2}	
Ba^{131}	4.2×10^{18}	12 d	2.4×10^{-5}	1.10	3.8×10^{-2}	3.8×10^{-2}	3.5×10^{-2}
Ba^{133}		38 h	0.058		6.6	6.46	3.6
Ba^{133m}		20 y	0.058		1.6×10^{-4}	1.6×10^{-4}	1.6×10^{-4}
Ba^{135m}		28.7 h	0.19		3.0×10^{3}	2.9×10^{3}	1.4×10^{3}
Ba^{137m}		2.6 m	0.60		6.0×10^{6}	0.108	
Ba^{139}		84 m	0.35		1.1×10^{5}	4.3×10^{4}	1.08
C^{14}	3.6×10^{19}	5,100 y	10^{-3}	4.7×10^{-3}	4×10^{-6}	4×10^{-6}	4×10^{-6}
Sr^{87m}	3×10^{18}	2.7 h	0.128	1.35	1.6×10^{4}	1.2×10^{4}	32.0
Sr^{89}		53 d	4×10^{-2}		0.92	0.92	0.84
	Total activity				2.8×10^{9}	1.2×10^{8}	2.84×10^{6}
	Total activity after 1 week					4,000 curies	

tions of the two media; the computations assume emission of 1 gm of neutrons.

The underwater explosion was assumed to occur in an infinite medium of water from the Schuylkill River.

The underground explosion was assumed to occur in an infinite medium of the earth's crust; density, 2.67 gm/cm³. Activities of the 18 most abundant elements were calculated.

* * *

This paper is a condensation of a report presented to The Philadelphia District Civil Defense Council. The report appeared in full in the October, 1951 issue of the *Journal of the Franklin Institute*.

Activities Induced by Underwater Explosion

Isotope produced	*Number of atoms per cm³*	*Half-life*	*Capture cross section (barns)*	*Activity at t = 0 (curies)*	*Activity at t = 1 hr (curies)*	*Activity at t = 24 hr (curies)*
Al^{28}	7×10^{15}	2.4 m	0.21	5,400	2.2×10^{-3}	
Ba^{131}	4.2×10^{14}	12 d	2.4×10^{-3}	6×10^{-6}	6×10^{-6}	6×10^{-6}
Ba^{133m}		38 h	0.058	0.10	0.10	0.04
Ba^{133}		20 y	0.058	2×10^{-5}	2×10^{-5}	9×10^{-6}
Ba^{135m}		28.7 h	0.19	0.46	0.46	0.20
Ba^{137m}		2.63 m	0.60	920.0	0.0092	9×10^{-178}
Ba^{139}		84 m	0.35	160.0	60.0	6×10^{-5}
B^{12}	1.1×10^{15}	0.027 s	0.04	1×10^{6}		
Cu^{64}	1.1×10^{15}	12.8 h	2.0	28	26.0	8.0
Cu^{66}		5 m	0.56	1,080	0.26	
Cr^{51}	10^{14}	2.65 d	0.5	0.28	0.28	0.27
Cr^{55}		1.3 h	1.4 × 10	0.002	0.001	2×10^{-18}
F^{20}	3×10^{14}	10.4 s	9.4×10^{-3}	160		
Pb^{209}	6×10^{13}	3.32 h	0.5	2.56	1.82	0.026
Ni^{59}	1.7×10^{13}	2×10^{5} y	2.9	4×10^{-9}	4×10^{-9}	4×10^{-9}
Ni^{63}		85 y	0.44	2×10^{-6}	2×10^{-6}	2×10^{-6}
Ni^{65}		2.6 h	1.7×10^{-3}	0.016	0.0096	8×10^{-5}
Mn^{56}	6×10^{14}	2.59 h	10.7×10^{-24}	380	246	1.6
K^{42}	1.4×10^{14}	12.4 h	6.7×10^{-3}	1.08	1.0	0.26
Na^{24}	2.5×10^{16}	15 h	0.63	160	152	54
Ag^{108}	3×10^{12}	2.3 m	23.0	280	2.8×10^{-7}	
Ag^{110m}		22 s	46.6	5.4×10^{4}		
Ag^{110}		225 d	1.1	8.0×10^{-4}	8.0×10^{-4}	8.0×10^{-4}
Sr^{87m}	1.7×10^{15}	2.7 h	0.128	10.8	8	0.032
Sr^{89}		55 d	4×10^{-3}	8×10^{-4}	8×10^{-4}	8×10^{-4}
Sn^{113}	10^{13}	105 d	0.012	8.0×10^{-6}	8.0×10^{-6}	8.0×10^{-6}
Sn^{125m}		9 m	0.039	0.4	6.0×10^{-3}	
Sn?		40 m	0.014	3.2×10^{-2}	2.0×10^{-2}	3.2×10^{-13}
Sn?		26 h	0.072	3.8×10^{-3}	3.7×10^{-3}	1.8×10^{-3}
Sn^{126}		10 d	0.009	6.4×10^{-5}	6.4×10^{-5}	5.8×10^{-5}
Sn?		400 d	0.018	8.6×10^{-6}	8.6×10^{-6}	8.6×10^{-6}
Zn^{65}	5×10^{13}	250 d	0.26	3.2×10^{-4}	3.2×10^{-4}	3.2×10^{-4}
Zn^{69m}		57 m	0.19	1.6	0.8	1.6×10^{-9}
Zn^{69}		13.8 h	0.054	1.3×10^{-3}	3.4×10^{-4}	3.2×10^{-4}
V^{52}	4×10^{13}	3.9 m	4.5	420	0.014	
Sb^{122}	3×10^{12}	2.8 d	3.8	0.028	0.026	0.022
Sb^{124}		60 d	1.1	0.004	0.004	0.004
Mo^{99}	10^{12}	67 h	0.10	2.2×10^{-4}	2×10^{-4}	2×10^{-4}
Mo^{101}		19 m	0.044	2.2×10^{-2}	3×10^{-4}	8×10^{-13}
Mo?		7 h	0.001	2.2×10^{-5}	2×10^{-5}	3×10^{-6}
O^{19}	3.3×10^{22}	31 s		2.6×10^{5}		
	Total activity			1.4×10^{6}	500	60
	Total activity after 1 week				<0.4 curies	

Dosage Calculator

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TWO BASIC CALCULATIONS confront the radiation monitoring expert when radioactive contamination is present following an explosion. The calculator* shown on the opposite page was designed to solve these problems, the measurement of dosage rate and dose, both of which arise because the radiation level changes rapidly, especially during the first few hours. The two examples given below show how these problems are solved.

To design a calculator for solving these problems, it is first necessary to choose an expression that properly represents, as a function of time, the decay of the residual radioactivity to be expected after an explosion. Decay curves for mixed fission products are shown in Fig. 1 on page C-3.

However, not only fission products contribute to contamination. As the only explosions likely to produce a residual radiation hazard are those that occur near, or under, ground or water, some radioactivity may result from capture of the neutrons released in fission. The most important of these induced activities is probably that of Na^{24}.† Although Na constitutes less than 2% of either sea water or average soil, the results of neutron capture by more abundant stable isotopes are either stable isotopes or activities too short lived to be of importance. If 5% of the fission-produced neutrons‡ were captured by Na, and the resulting Na^{24} mixed with the fission products, the gross decay would differ appreciably (12% at most) from the fission-product decay only around 1 day.

Hunter§ has described a circular slide rule, similar in function to the present calculator but of different design, based on the decay law calculated for pure fission products. However, the uncertainty introduced by the probable presence of induced activities is small, and the uncertainty of field measurements on which calculations will be based is large. Thus it seemed reasonable, for the present device, to use the approximate decay law $A(t) = ct^{-1.2}$. The exponent, -1.2, is the slope of the Way-Wigner curve (Fig. 1, p. C-3); $A(t)$ is the dosage rate; t is the time measured from the explosion; c is an arbitrary constant determined by the first setting of the calculator in solving problem 1. In solving problem 2, the calculator integrates $A(t)$ between the values of t that mark the start and end of exposure.

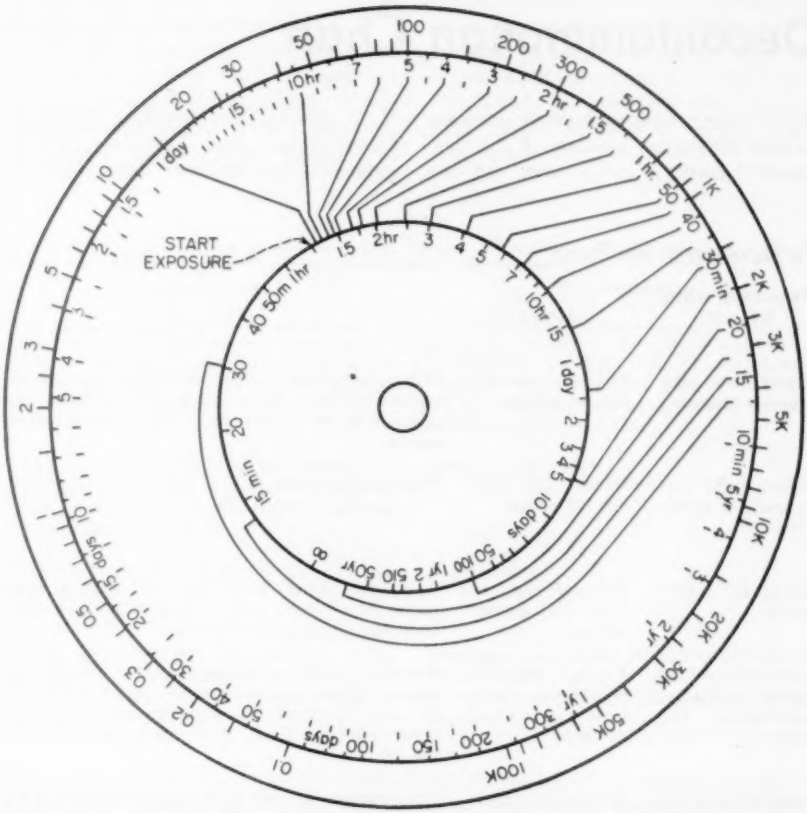
Problem 1. If the radiation level, or dosage rate, in a contaminated area was measured at a certain time in the past, what is the level now? What will it be at any given future time? To illustrate the use of the dosage calculator shown in the illustration, assume that a meter reading of 300 mr/hr is obtained in the contaminated area 2 hr

* Developed for the Connecticut State Office of Civil Defense. Others who wish them may obtain calculators at a cost of one dollar each from "Radiation Calculator," P. O. Box 27, Storrs, Conn.

† "The Effects of Atomic Weapons," Chapt. 8 (U. S. Government Printing Office, Washington, D. C., 1950)

‡ For this estimate, it is assumed that one neutron is absorbed and 2.5 are released per fission, leaving 1.5 neutrons available for capture [Nuclear data for low-power reactors, NUCLEONICS **8**, No. 1, 78 (1951)]

§ H. F. Hunter, NRDL report AD-234(H).



Radiation-dosage calculator. The outermost scale remains fixed; the other two scales, mounted on separate concentric disks, are free to turn independently of each other. The scales are set for solving the two problems discussed below

after the explosion of an atomic bomb.

Solution. Locate the number "300" on the outermost scale. Then turn the scale just inside it until "2 hr" appears next to "300," as shown above. Locate the past or future time on the same scale and read the radiation level, or dosage rate, in mr/hr at that time next to it on the outermost scale.

Problem 2. If a man enters a contaminated area at any given time and leaves at any later time, what dose of radiation will he receive during this time? Assume that 1.25 hr after the explosion he entered the area where the reading of 300 mr/hr was made 2 hr after the explosion.

Solution. Set the two outer scales as in Example 1. Then set "1.25 hr" on the innermost scale next to the "Start Exposure" arrow. To find the dose accumulated up to, say, 4 hr after the explosion, find "4 hr" on the innermost scale, and follow the guide lines to the outermost scale. At this point on the outermost scale, the dose is given in mr, in this case about 700 mr.

* * *

The author wishes to thank his colleagues, S. S. Friedland and L. E. Williams, for valuable criticisms and suggestions.

Decontamination Chart

RADIOACTIVE CONTAMINATION presents serious difficulties because of the personnel hazard it can create. At the U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY, San Francisco, Calif., extensive studies have been made of

To Decontaminate Paint

Decontaminating Material	Action	Technique
Water from high pressure sources	Dissolving and erosive action	Work from high to low areas to minimize recontamination. Spraying should be from upwind side of object to avoid contaminated spray.
Steam (with detergent, if available)	Dissolving and erosive action	Same as for water.
Soapless detergents	Emulsifying action on greasy surfaces	Apply hot solution by standard wiping technique (one-minute rub). Concentration should be sufficient to produce suds.
Complexing agents: oxalates, carbonates, citrates	Forms soluble complexes with contaminated material	Solution should contain 3% (by weight) of agent. Spray on surface and keep moist for 30 min by periodic spraying with solution. After allotted time, flush material off with water.
Trisodium phosphate	Grease and paint cutter	Rub surface 1 min with rag moistened with hot, 10% solution. Do not allow solution to drip. Wipe dry with a second rag. Use clean rag surface for each application.
Organic solvents (industrial stripping compounds)	Grease and paint remover	Entire surface may be immersed in solvent. Solvent may also be applied by standard wiping technique for detail paint removal.
Caustics (sodium, calcium, or potassium hydroxide)	Paint remover	Let paint mixture remain on surface for 2 hours, then wash off with high-pressure stream of water. Remove remaining paint with long-handled scrapers and use a dilute acid rinse.
Wet sandblasting	Abrasion	Standard technique. Follow up with vacuum treatment to concentrate contaminated abrasive.

To Decontaminate Asphalt

Wet scrubbing with mechanical street-sweepers	Abrasion	Wet scrubbing technique, followed by flushing with water.

decontamination. The results of these studies are summarized here.

The purpose of surface decontamination is to remove the radioactivity without impairing the utility of the contaminated object. For each type of surface listed below, methods of decontamination are listed in the order of increasing severity of action on the surface. A severe action normally is the most effective, but the future utility of the surface may require that milder methods of decontamination be used.

Advantages	Disadvantages
Most practicable method for gross decontamination from a distance. Contamination reduced by 50%.	Protection needed from contaminated spray. Runoff must be controlled. Should not be used on a surface covered with contaminated dust.
Most practicable method for decontaminating large horizontal, vertical, and overhead surfaces. Contamination reduced by approximately 90%.	Same as for water.
Reduces activity to tolerance in one or two applications.	Mild action.
Holds contamination in solution. Contamination (unweathered surfaces) reduced by 75% in 4 min. Easily stored, nontoxic, noncorrosive.	Requires application from 5 to 30 min for effectiveness. Has little penetrating power; hence of small value on weathered surfaces.
Reduces activity to tolerance in one or two applications. Good method for vertical and overhead surfaces.	Hand application method slow and laborious. Must not be used on painted aluminum or magnesium.
Quick dissolving action makes solvents useful on vertical and overhead surfaces.	Requires good ventilation and fire precautions.
Minimum contact with contaminated surface. Contamination reduced almost 100%.	Applicable only on horizontal surfaces. Personnel hazard. Not to be used on aluminum or magnesium.
Complete removal of surface and contamination. Feasible for large-scale operations.	Contaminated sand spread over large area. Method too harsh for many surfaces.
No direct contact with surface; contamination may be reduced to tolerance.	Reisdual contamination fixed into asphalt. If road is subject to further contamination, may require respraying.

To Decontaminate Metal

Decontaminating Material	Action	Technique
Water	Dissolving and erosive action	(See Paint)
Detergents	Emulsifying action	(See Paint)
Organic solvents	Dissolving power	(See Paint)
Complexing agents: oxalates, carbonates, citrates	Forms soluble complexes with contaminated material	Spray 3% solution of agent on surface and keep moist for 30 min by periodic spraying with water. Afterwards, agent should be flushed off.
Inorganic acids (hydrochloric and sulfuric)	Dissolving power with respect to metals and porous deposits	Allow acid solution (9–18% hydrochloric or 3–6% sulfuric) to react on weathered surface for 1 hour. In circulatory systems, from 2–4 hours. Acid should be neutralized with mild alkali and surface flushed with water.
Acid mixtures	Dissolving action	(See Inorganic acids). Mixture: 0.1-gal hydrochloric, 0.2-lb sodium acetate, 1.0-gal water.
Hand abrasion (buffers, grinders)	Abrasion	The surface should be kept in a moistened condition to minimize the airborne contamination.
Wet sandblasting	Abrasion	(See Paint)

To Decontaminate Concrete or Brick

Vacuum blasting	Abrasion	Conventional technique. Hold tool flush to surface to prevent escape of contamination.
Vacuum cleaning (vapor dust trap)	Vacuum-suction of dry particles	Conventional technique. Use special filter to prevent escape of contamination through exhaust.

To Decontaminate Tile

Trisodium phosphate	Dissolving action	Scrub hot 10% solution into surface and flush thoroughly with water.

To Decontaminate Wood

Floor chippers and grinders	Removal of top wood	Conventional techniques. Protect personnel against dust hazard.

To Decontaminate Soil

Land scrapers (pans)	Removal of top soil	Keep soil damp but not soaked before operations.

Advantages	Disadvantages
Contamination reduced by 50%.	(See Paint)
Removal of oil or grease films.	(See Paint)
Stripping of grease.	(See Paint)
Holds contamination in solution.	Good only on horizontal surfaces. Limited value on weathered surfaces.
Fast, complete decontamination.	Good ventilation required, for acid fumes toxic to personnel. Possibility of excessive corrosion. Acid mixture cannot be safely heated.
Action of weak acid. Reduces contamination on unweathered surfaces.	(See Inorganic acids)
Useful for detail cleaning.	Impractical on porous surfaces. Follow-up procedure required to pick up powdered contamination.
(See Paint)	(See Paint)
Direct removal of contaminated dust.	Contamination of equipment.
Direct removal of contaminated dust.	Contamination of equipment.
Simplicity of method.	Deteriorating effect upon tile.
Complete removal of contamination by taking off $\frac{5}{16}$-in. of wood.	Dust hazard. Cannot use moisture.
Complete decontamination possible.	Constant decontamination of equipment required. Disposal of large amounts of soil required.

Survey Meters for Water Monitoring

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AN EARLY EVALUATION of the degree of contamination in a community's water supply following an atomic bomb explosion is essential not only to prevent ingestion of dangerous amounts of fission products, but also to avoid the equally serious mistake of denying a stricken community access to drinking water which in fact could be used with safety. The purpose of the work described here was to determine whether survey instruments in common use for beta and gamma area monitoring could be adapted for emergency water monitoring during a period of 30 days following an explosion.

Before embarking on the instrument tests it was necessary to take a position regarding three general questions.

1. What is the level of beta-emitting fission products which may be ingested without injury?

2. Can a single available beta emitter be used to simulate a fission-product mixture? If so, what is the best choice?

3. Can the alpha emitters be neglected in this early survey?

Suggested emergency levels for radioactive contamination from fission product activity in drinking water appear in Table 1.

The use of a single beta emitter as a contaminant for the test-water solutions rather than the use of a fission-product mixture is a considerable experimental convenience. The practice may be defended by pointing to the gross similarity of shape between the characteristic spectrum of a single beta emitter and the mixed-fission-product beta spectra for 12 hours, 24 hours, and 28 days, as built up by Condit, Dyson, and Lamb.* Since the spectrum shape is approximately similar, a single beta emitter with an appropriate maximum energy would be a reasonable substitute for fission products in the tests on contaminated water. P^{32} (which emits a beta particle of 1.7-Mev maximum energy) was readily available, and its maximum energy was initially thought to be in the proper range. Accordingly, the majority of the experiments were done with water to which a known amount of P^{32} had been added. However, it is now thought that the beta particles from P^{32} are on the whole more energetic than the beta particles from a mixed-fission-product source of an age appropriate for the purposes of the present study.

Before concluding the experiments we were able to obtain a mixed-fission-product source and to compare results obtained with fission-product test solutions and P^{32} test solutions.

In considering whether water must be monitored for alpha as well as beta contamination, it may be shown that if the source of alpha contamination is an atomic bomb burst and the water has been demonstrated safe for consump-

* R. I. Condit, J. P. Dyson, W. A. S. Lamb, Private communication.

TABLE 1
Suggested Emergency Levels for Drinking Water in Period Immediately Following Explosion*

Consumption period (days)	*Proposed maximum beta-activity levels*			
	Safe		*Acceptable risk*	
	(curies/cm³)	(dpm/cm³)	(curies/cm³)	(dpm/cm³)
10	3.5×10^{-9}	7.7×10^{3}	9×10^{-8}	2.0×10^{5}
30	1.1×10^{-8}	2.6×10^{3}	3×10^{-8}	7×10^{4}
	Proposed maximum alpha-activity levels			
10	2×10^{-10}	440	5×10^{-9}	1.1×10^{4}
30	6.7×10^{-11}	145	1.7×10^{-9}	3.7×10^{3}

* Made available to the Office of Civilian Defense by the Division of Biology and Medicine of the U. S. Atomic Energy Commission.

tion as regards beta-emitting fission products, the hazard of alpha particles from plutonium in the water is essentially negligible, at least for the first thirty days following a burst.

Experimental Procedure and Results

Six commercially available instruments of the thin-side-wall, G-M tube, beta-gamma survey type have been tested. The beta-particle contamination of water could be read in terms of counts per minute or milliroentgens per hour on most of these instruments, neither term having much significance. However, due to the variation in sensitive volume of the G-M tubes of the several instruments, readings of counts per minute would not have the same meaning on all instruments. This variation is corrected for by calibrating the instruments to read mr/hr for radium gamma rays. Although the term mr/hr has no meaning in measuring beta-particle contamination, it does serve as a means of obtaining uniform readings on a wide variety of instruments of the class studied. A conversion factor can be established to convert readings in mr/hr to μc/liter. Therefore, sensitivity adjustments were first made on all instruments so that they read as nearly as possible the correct mr/hr when exposed to gamma rays from a known radium source.

It should be emphasized at this point that it was not our intent to sample the instruments as to respective merit, and we have not done so.

As has been stated, P^{32} was used with tap water to make up test solutions. The activity concentrations covered the range from 0.1 to 80 μc/liter. Data were obtained with the P^{32} solutions contained in a shallow, rectangular pan, 28 × 43 cm, filled to a solution depth of about 1 cm. The G-M tube was supported in position 5.3 cm from the center of the tube to the water surface. Instruments with directional windows were oriented with the window looking directly at, and centered over, the water.

Of 9 instruments tested, (2 each of 3 types, 1 each of the others) all were sufficiently sensitive for satisfactory detection of the beta activity from P^{32} in the concentration range from 1 to 90 μc/liter. The meter readings for each instrument increase linearly with the activity of the test solutions. The readings for the P^{32} solutions for the group of instruments range from about 2 mr/hr for 5 μc/liter up to 13 mr/hr for 80 μc/liter; the least sensitive instru-

FIG. 1. Water monitoring kit in use

ment gave about 6 mr/hr for 80 μc/liter.

The background reading of these instruments is about 0.02 mr/hr, equivalent to about 0.34 μc/liter of P^{32} when measured under the above conditions.

To the limited extent to which the particular instrument tested may be regarded as typical of those sold and distributed for use, the data suggest that if 25% accuracy in measurement is desirable, the instruments should be calibrated before use, or a convenient reference standard should be supplied, so that comparison readings may be made. The latter procedure would also insure against changes in the sensitivity of instruments in use.

From general considerations it will be expected that a beta-detecting instrument held at a constant distance from the surface of a water solution of a beta-active material will show an increased reading with increase in solution depth up to a water thickness which is just able to absorb the most energetic beta particles. Increase of the depth of solution beyond this point will produce no increase in the beta reading of the instrument. To plan specific procedures for monitoring water it will be helpful to know what minimum depth of water corresponds to a maximum instrument reading for a given contamination concentration. Experiments were performed to supply this information.

A flat-bottomed 18 × 28-cm pan was used to hold 18.7 μc/liter of P^{32} solution. Readings were taken for a series of solution depths with the instrument held 5.4 cm from the water surface. The results show that 90% of the maximum instrument reading is obtained when the solution thickness is 2 mm.* Below

* For a mixed-fission-product source, the solution thickness for maximum reading will be even less since the beta particles are less energetic.

Procedure for Monitoring Water Contaminated by Fission Products

The following procedure is for use with a thin-side-wall G-M tube and a beta or gamma survey meter. An 8-ounce container holds the sample, and two Bioplastic-coated standards, *A* and *B*, are used. This equipment is discussed in the text and is shown in Fig. 1.

To monitor the contaminated water. . .

1. Invert lid to expose standard *A*, deposited on inner flat surface.

2. Turn on the survey meter. Note the background reading.

3. Slide back beta shield so that tube is exposed. Rest probe on lid rim with window centered over, and looking directly at, sample *A*. Read meter.

4. Fill container to beaded mark with the water to be tested. Resting the tube detector on container rim (window looking directly at water surface), note the meter reading. If reading is less than that obtained with standard *A*, the water may be judged safe for ten-day consumption.

5. If reading is high compared to standard *A*, and an emergency condition exists for drinking water, repeat the procedure using standard *B* for comparison. If the reading on the water is less than that obtained with standard *B*, the water may be used on a ten-day basis; the hazard may be regarded as an acceptable risk for emergency use.

6. Since meter response is linear with water activity, the water activity may be read from the straight-line graph drawn between the points for meter reading against activity for samples *A* and *B*.

2 mm the curve of counting rate against depth of solution tails off sharply.

To examine the effect on the meter reading of container size and distance between G-M tube and water surface, a number of different sized containers were examined. These containers were filled with a 106-μc/liter P^{32} solution, and readings were taken with the probe held at distances ranging from 1 to 16 cm from the surface of the water. In all cases the readings decreased as the distance increased. For the containers having smaller surface area, however, this decrease was more rapid. Thus, with increasing distance, the tube sees a source that looks more like a point and less like a plane. The implication of these data in the problem of monitoring water is clear. If the monitor wishes to avail himself of the conveniences of a small container, he must make his measurements at a constant distance and must have calibration data at this distance available.

Water Container and Calibration Sources

In the interest of simplifying the water monitoring procedure and to make the measurements independent of the instrument calibration, the authors propose to supplement the survey meter with a pocket-size water container and two calibration sources. Calibration source *A* has its activity adjusted so that the meter reading obtained is equal to the reading when the container is filled to the mark with a solution of mixed fission products having an activity of 3.5 μc/liter, the concentration which has been designated safe for ten-day consumption. Calibration source *B* has been adjusted to give a meter reading equivalent to a water contamination of 90 μc/liter, the ten-day acceptable risk level. By direct

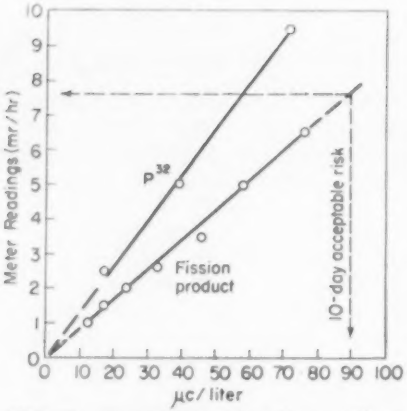

FIG. 2. Comparison of meter readings obtained with solutions of graded activity for P^{32} and mixed fission products as the beta sources

comparison of the water reading with the reading obtained from sources *A* and *B*, the water monitor can immediately answer the questions: Is the water safe for ten-day consumption? If not, is the concentration of fission products less than the acceptable risk for ten-day consumption?

The water container used is a metal, pharmaceutical salve box of 8-ounce capacity. This cylindrical container is 3¾ in. in diameter and about 1¼ in. in depth. A bead has been formed along the circumference 5/16 in. down from the rim to act as a lid stop. In our procedure we filled the container with solution to this convenient mark.

To set up the calibration standards at the suggested activity levels, we made use of a mixed-fission-product sample obtained from Oak Ridge National Laboratory. From the fission-product sample a series of solutions of graded activity concentration were made up and meter readings were recorded for each solution contained in the salve box filled to the mark. The tube probe rested on the rim of the container. For the sake of comparison, a series of P^{32} solutions were tested at the same time. The results are plotted in Fig. 2.

The calibration sources described below were made up so that with tube wand resting on the lid rim the instrument read 0.26 mr/hr (equivalent to 3.5 μc/liter fission-product mixture) for sample *A*, and about 7.6 mr/hr (equivalent to 90 μc/liter) for sample *B*. It will be noted that a calibration based on P^{32} solution activities would underestimate the real activity of a solution of fission products.

The calibration sources were deposited on the inside surfaces of two lids as follows: Calibration source *A* was made by thoroughly mixing about 80 mg of UO_2 (black oxide) with 2 gm of Ward's Bioplastic and allowing this mixture to spread evenly over the inside flat surface. Calibration source *B* was made by mixing about 2 gm of UO_2 with 2 gm of plastic. The coatings on the lids hardened within two weeks if no catalyst was added; within two days with catalyst added. The layers formed were tough, moderately elastic, and very adherent to the metal lids. No noticeable changes were produced in the plastic by X-rays (3,000 r), heat (8 hr, 100° C), or cold (3 days, 0° C).

There are, of course, many other possible methods of producing such calibration samples. As a result of the kind cooperation of Dr. Kreidel of Bausch and Lomb Optical Company, Rochester, New York, we were able to explore the possibility of using uranium-containing glass. It was found possible to produce transparent glass disks about ¼ in. thick and 3¼ in. in diameter having the requisite activity. The advantages of light weight and ruggedness, however, favor the Bioplastic-coated lids as sources as opposed to the glass disks. Bioplastic appears to be an excellent vehicle for the uranium oxide, although, doubtless, other suitable vehicles could be found.

NUCLEONICS

Annual

BUYERS' GUIDE SECTION

1951 1952

NUCLEONICS BUYERS' GUIDE

1951–1952

An alphabetical listing of the manufacturers of equipment, materials, components and allied products used in basic research, development and applications of nuclear energy.

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Compiled by the Research Staff of NUCLEONICS.

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Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Furst Electronics, 20 S. Jefferson St., Chicago 6, Ill.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.
McIntosh Engineering Laboratory, Inc., 320 Water St., Binghamton, N. Y.
Melpar Inc., 452 Swann Ave., Alexandria, Va.
Network Mfg. Corp., 213 W. 5th St., Bayonne, N. J.
Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Remler Company, Ltd., 2101 Bryant St., San Francisco, Calif.

Apparatus

Rosen Engineering Products, Inc., Raymond, 32nd & Walnut St., Philadelphia 4, Pa.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Spencer-Kennedy Labs, Inc., 186 Massachusetts Ave., Cambridge 39, Mass.
Stephens Mfg. Corp., 8538 Warner Drive, Culver City, Calif.
Tech Laboratories, Inc., Bergen & Edstall Blvds., Palisades Park, N. J.
Technology Instrument Corp., 531 Main St., Acton, Mass.
Tektronix, Inc., P. O. Box 831, Portland 7, Ore.
Television Equipment Corp., 238 William St., New York 7, N. Y.
U. S. Electronic Co., 262 Conner St., New Haven 11, Conn.

ANALYZERS—Coincidence and Anti-coincidence

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.

ANALYZERS—Gas

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Applied Physics Corp., 362 W. Colorado St., Pasadena 1, Calif.
Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.
Beckman, Inc., Arnold O., 1020 Mission St., South Pasadena, Calif.
Cambridge Instrument Co., Inc., 3786 Grand Central Terminal, New York 17, N. Y.
Davis Emergency Equipment Co., Inc., 252 Halleck St., Newark, N. J.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Engelhard, Inc., Charles, 850 Passaic Ave., East Newark, N. J.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Hays Corp., Michigan City, Ind.
Liston-Becker Instrument Co., Inc., 20 Beckley Ave., Stamford, Conn.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
National Research Corp., 70 Memorial Drive, Cambridge 42, Mass. ADV. PGS. 94, 95.
Perkin-Elmer Corp., Norwalk, Conn.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Will Corp., Rochester 3, N. Y.

ANALYZERS—Pulse Height

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

APPARATUS—Distilling

Barnstead Still & Sterilizer Co., 222 Lanesville Terrace, Forest Hills, Boston 31, Mass.
Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Corning Glass Works, Corning, N. Y.
Distillation Products Industries, Rochester 3, N. Y.
Eberbach Corporation, Ann Arbor, Mich.

Apparatus

Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Laboratory Construction Co., 1113–1115 Holmes St., Kansas City, Mo.
Pfaudler Co., East Ave. & Clark St., Rochester, N. Y.
Will Corp., Rochester 3, N. Y.

APPARATUS—Drying, (for use on gases)

Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Elsler Engineering Co., 730 S. 13th St., Newark 3, N. J.
Pittsburgh Lectrodryer Corp., P. O. Box 1766, Pittsburgh, Pa.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
United States Testing Co., Hoboken, N. J. ADV. PG. 103.
Will Corp., Rochester 3, N. Y.

APPARATUS—Drying, Vacuum

Distillation Products Industries, Rochester 3, N. Y.
Electric Hotpack Co., Inc., 5035 Cottman St., Philadelphia, Pa.
National Research Corp., 70 Memorial Drive, Cambridge 42, Mass. ADV. PGS. 94, 95.
Optical Film Engineering Co., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 140.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Struthers Wells Corp., Warren, Pa.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.
Will Corp., Rochester 3, N. Y.

APPARATUS—Filter Micro, Filter Beaker Method

Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Will Corp., Rochester 3, N. Y.

APPARATUS—Filter Micro, Filter Crucible Method

Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Will Corp., Rochester 3, N. Y.

APPARATUS—Gas, Complete with Pipettes

Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Will Corp., Rochester 3, N. Y.

APPARATUS—Micro-Drying

Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.

APRONS

Bullard Co., E. D., 275 Eighth St., San Francisco 3, Calif.
Colloid Equipment Co., Inc., 50 Church St., New York, N. Y.
Goodrich Co., B. F., 448 S. Main St., Akron, Ohio
Johns-Manville, 22 E. 40th St., New York 16, N. Y.

Balances

ASBESTOS—Filtering

Johns-Manville, 22 E. 40th St., New York, N. Y.
Will Corp., Rochester 3, N. Y.

ASHING DISHES

Corning Glass Works, Corning, N. Y.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Will Corp., Rochester, N. Y.

ASPIRATOR UNITS

Phillips-Drucker, 2245 S. Vandeventer Ave., St. Louis, Mo.

AUTOCLAVES

Barnstead Still & Sterilizer Co., 222 Lanesville Terrace, Forest Hills, Boston 31, Mass.
Bethlehem Steel Co., Bethlehem, Pa.
Boekel & Co., Inc., Wm., 509–519 Vine St., Philadelphia 6, Pa.
General Mixing Equipment Co., 411 N. 3rd St., Philadelphia, Pa.
Glas-Col Apparatus Co., Inc., 711 Hulman St., Terre Haute, Ind.
National Lead Co., 111 Broadway, New York 6, N. Y.
Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Pelton & Crane Co., 632 Harper Ave., Detroit, Mich.
Pfaudler Co., East Ave. & Clark St., Rochester, N. Y.
Struthers Wells Corp., Warren, Pa.
Will Corp., Rochester 3, N. Y.

BADGES—Film

Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Minimax Co., 5905 N. Clark St., Chicago 26, Ill.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
St. John X-Ray Laboratory, Califon, N. J.
Samples Machine Co., A. M., 506 N. Central Ave., Knoxville, Tenn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

BALANCES—Analytical

Ainsworth & Sons, Inc., Wm., 2151 Lawrence St., Denver 2, Colo.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Becker Division, Christian, Torsion Balance Co., Clifton, N. J.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Seederer-Kohlbusch, Inc., 25 S. Van Brunt St., Englewood, N. J.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Voland & Sons, Inc., 32 Relyea Place, New Rochelle, N. Y.
Will Corp., Rochester 3, N. Y.

BALANCES—Heavy Duty

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

Balances

Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill. ADV. PG. 136.
Will Corp., Rochester 3, N. Y.

BALANCES—Microchemical

Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Thomas Co., Arthur H., W. Washington Square, Philadelphia, Pa.
Will Corp., Rochester 3, N. Y.

BALANCES—Scale, Analytical

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Exact Weight Scale Co., 1017 W. Fifth Ave., Columbus 8, Ohio
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Will Corp., Rochester 3, N. Y.

BALANCES—Semi-Micro

Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Seederer-Kolbusch, Inc., 25 S. Van Brunt St., Englewood, N. J.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Will Corp., Rochester 3, N. Y.

BALANCES—Spring

Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Humboldt Mfg. Co., 2016 N. Whipple, Chicago, Ill.

BALANCES—Torsion

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Humboldt Mfg. Co., 2016 N. Whipple, Chicago, Ill.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Will Corp., Rochester 3, N. Y.

BALL MILLS

Allis Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 1, Wis.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Industrial Products Engineering Co., 44–25 Hunter St., Long Island City, N. Y.
International Engineering, Inc., 1200 Bolander Ave., Dayton, Ohio
Mine & Smelter Supply Co., P. O. Box 5270, Terminal Annex Station, Denver 17, Colo.
U. S. Stoneware Co., Akron 9, Ohio
Will Corp., Rochester 3, N. Y.

BALLOONS—Cosmic Ray

Aeronautical Research Labs., General Mills, Inc., 2010 E. Hennepin Ave., Minneapolis 13, Minn. ADV. PG. 96.

BAROMETERS—Precision Mercurial

Eberbach Corporation, Ann Arbor, Mich.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.

Blenders

Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

BATHS—Constant Temperature

Bowser Technical Refrigeration Div., Bowser Inc., Terryville, Conn.
Cerro de Pasco Corp., 40 Wall St., New York 5, N. Y.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Greiner Co., Emil, 20–26 N. Moore St., New York 13, N. Y.
Krebs Electric & Mfg. Co., Inc., 237–239 Lafayette St., New York 12, N. Y.
Metal Products Corp., 48 W. 19th St., Weehawken, N. J.
National Appliance Co., Swan Island, Portland 18, Ore.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.
Will Corp., Rochester 3, N. Y.

BATTERIES

Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Bright Star Battery Co., 200 Crooks Ave., Clifton, N. J.
Burgess Battery Co., Battery Div., Freeport, Ill.
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Goodyear Tire & Rubber Co., Akron, Ohio
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Kellogg Switchboard & Supply Co., 6655 S. Cicero St., Chicago 38, Ill.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
National Carbon Co., A Division of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Radio Corp. of America, RCA Victor Div., Tube Dept., 415 S. Fifth St., Harrison, N. J. ADV. PGS. 91, 106, 137.
Specialty Battery Co., Madison 4, Wisconsin.

BEARINGS—Miniature

Miniature Precision Bearings, Inc., Keene, N. H.

BELLOWS

Bohn Wood Products Co., Route 30 E, Fort Wayne, Ind.

BIOCHEMICALS

See also—Isotope Labeled Compounds

Abbott Laboratories, North Chicago, Ill.
General Biochemicals, Inc., Laboratory Park, Chagrin Falls, Ohio

BI-METALS—Thermostatic

Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Gas & Oil Industry Labs., Inc., 2 Paine Ave., Irvington, N. J.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Sherman & Co., 3607 Prince St., Flushing, N. Y.
Will Corp., Rochester 3, N. Y.

BLENDERS—Laboratory

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

Blowers

Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
General Mixing Equipment Co., 411 N. 3rd St., Philadelphia, Pa.
Industrial Products Engineering Co., 44–25 Hunter St., Long Island City, N. Y.
Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Will Corp., Rochester 3, N. Y.

BLOWERS—Laboratory

American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Breuer Electric Mfg. Co., 5100 N. Ravenswood Ave., Chicago 40, Ill.
Buckeye Air Compressor Co., 414 Littell Ave., Dayton 4, Ohio
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Clarage Fan Co., 719 Porter St., Kalamazoo, Mich.
Commercialaire, Inc., 302 Pacific St., Brooklyn 2, N. Y.
Eberbach Corporation, Ann Arbor, Mich.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electric Blower Co., 350 Atlantic Ave., Boston, Mass.
Electrovent Fan & Mfg. Co., 812 W. Lake St., Chicago 7, Ill.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.
Fasco Industries, Inc., Rochester 2, N. Y.
Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, Ill.
Industrial Products Engineering Co., 44–25 Hunter St., Long Island City, N. Y.
Kewaunee Mfg. Co., 5083 S. Center St., Adrian, Mich. ADV. PG. 131.
Ripley Co., Inc., 22 W. First St., Mt. Vernon, N. Y.
Rotron Mfg. Co., 7 Schoonmaker Lane, Woodstock, N. Y.
Trane Co., La Crosse, Wis.
United Blower Co., Inc., 193 Center St., New York, N. Y.
United States Air Conditioning Corp., Como Ave., SE at 33rd, Minneapolis 14, Minn.
Western Blower Co., 1800 Airport Way, Seattle 66, Wash.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

BOOSTERS—Battery

Electric Service Systems, Inc., 1330 Quincy St., N.E., Minneapolis 13, Minn.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Opad-Green Co., 71 Warren St., New York, N. Y.
Peschel Electronics, Inc., 12 Garden St., New Rochelle, N. Y.

BOTTLES—Stoneware

General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio

BOXES—Dry Ice

Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 27, Mass.
Industrial Products Engineering Co., 44–25 Hunter St., Long Island City, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.

Bridges

BOXES—Glove

Blickman, Inc., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 4.
Bohn Wood Products Co., Route 30 E, Fort Wayne, Ind.
Industrial Products Engineering Co., 44–26 Hunter St., Long Island City, N. Y.
Kewaunee Mfg. Co., 5083 S. Center St., Adrian, Mich. ADV. PG. 131.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.

BRIDGES—Conductivity

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Industrial Instruments, Inc., 17 Pollack Ave., Jersey City, N. J.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Network Mfg. Co., 215 W. 5th St., Bayonne, N. J.
Will Corp., Rochester 3, N. Y.

BRIDGES—Electrical

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Cambridge Instrument Co., Inc., 3786 Grand Central Terminal, New York 17, N. Y.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Clough Brengle Co., 6014 N. Broadway, Chicago, Ill.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Daven Co., 191 Central Ave., Newark 4, N. J.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Elm Laboratories, 18 South Broadway, Dobbs Ferry, N. Y.
Gaveco Labs., Inc., 2 East End Ave., New York 21, N. Y.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Instrument Laboratories, 315 W. Walton Place, Chicago, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Marconi Instruments Ltd., 23–25 Beaver St., New York 4, N. Y.
Network Mfg. Corp., 213 W. 5th St., Bayonne, N. J.
Polytechnic Research & Development Co., 202 Tillary St., Brooklyn, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.

BRIDGES—Temperature

Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.

Bridges

Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.

BRIDGES—Wheatstone

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Elm Laboratories, 18 South Broadway, Dobbs Ferry, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Industrial Instruments, Inc., 17 Pollack Ave., Jersey City, N. J.
Instrument Laboratories, 315 W. Walton Place, Chicago, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Network Mfg. Corp., 213 W. 5th St., Bayonne, N. J.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Shallcross Mfg. Co., 10 Jackson Ave., Collingdale, Pa.
Special Instrument Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Tagliabue Instrument Div., Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.

BRIQUETTING PRESS

Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Stokes Machine Co., F. J., Frankford Station, P. O., Philadelphia 20, Pa.
Will Corp., Rochester 3, N. Y.

BURETTES—Automatic

Infilco Inc., P. O. Box 5033, Tucson, Ariz.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Will Corp., Rochester 3, N. Y.

BURNERS—Blast

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Humboldt Mfg. Co., 2016 N. Whipple, Chicago, Ill.
Will Corp., Rochester 3, N. Y.

BURNERS—Cross-Fire

Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Litton Industries, San Carlos, Calif.

BURNERS—Gas Hot Plate

Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Hones, Inc., Charles A., 122 S. Grand Ave., Baldwin, N. Y.
Will Corp., Rochester 3, N. Y.

BURNERS—Laboratory

Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eimer & Amend, 635 Greenwich St., New York, N. Y.

Cameras

Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Fisher Mfg. Co., Inc., John C., 37–29, 9th St., Long Island City 4, N. Y.
Hones, Inc., Charles A., 122 S. Grand Ave., Baldwin, N. Y.
Humboldt Mfg. Co., 2016 N. Whipple, Chicago, Ill.
Linde Air Products Co., Unit of Union Carbide & Carbon Corp., 30 E. 42nd St., New York, 17, N. Y.
Litton Industries, San Carlos, Calif.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Will Corp., Rochester 3, N. Y.

BURNERS—Micro

Fisher Mfg. Co., Inc., John C., 37–29 9th St., Long Island City 1, N. Y.
Radiation Counter Labs, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Will Corp., Rochester 3, N. Y.

BURNERS—Quartz

Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.
Menlo Research Laboratory, Menlo Park, Calif.
Will Corp., Rochester 3, N. Y.

BUSHINGS—Hermetically Sealed

American Lava Corp., Chattanooga 5, Tenn. ADV. PG. 97.
Corning Gass Works, Corning, N. Y.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.
Hermetic Seal Products Co., 29–37 So. 6th St., Newark, N. J.
Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.

CAGES—Animal

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Blickman, Inc., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 4.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., Boston 27, Mass.
Fischer-Nelson Corp., 210 W. Michigan St., Milwaukee 3, Wis.
Harford Metal Products, Inc., P. O. Box 459, Aberdeen, Md.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Will Corp., Rochester 3, N. Y.

CALORIMETERS

Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Parr Instrument Co., Moline, Ill.
Will Corp., Rochester 3, N. Y.

CAMERAS—Recording

Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Beckman & Whitley Inc., San Carlos, Calif.
Berndt-Bach, Inc., 7377 Beverly Blvd., Los Angeles 36, Calif.
Electrodyne Co., 32 Oliver St., Boston, Mass.

Cameras

Fairchild Camera & Instrument Corp., 88–06 Van Wyck Blvd., Jamaica 1, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hathaway Instrument Co., 1315 S. Clarkson St., Denver 10, Colo.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Leitz, Inc., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
Miller Corp., William, 325 N. Halstead Ave., Pasadena 8, Calif.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.

CAMERAS—Television

Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Diamond Power Specialty Corp., Lancaster, Ohio
Du Mont Laboratories, Inc., Allen B., Instrument Div., 1000 Main Ave., Clifton, N. J.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137.
Television Equipment Corp., 238 William St., New York, N. Y.

CAMERAS—X-Ray

Central Research Laboratories, Inc., Red Wing, Minn.
Fairchild Camera & Instrument Corp., 88–06 Van Wyck Blvd., Jamaica 1, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
North American Philips Co., Inc., 100 E. 42nd St., New York 117, N. Y.
Picker X-Ray Corp., 300 Fourth Ave., New York 10, N. Y.
St. John X-Ray Laboratory, Califon, N. J.

CAPACITORS

NOTE: Various types of capacitors are not indicated in this listing. Contact manufacturer for specific type (s) desired.

Aerovox Corp., 740 Belleville Ave., New Bedford, Mass.
Asheville Schoonmaker Mica Co., 350 Broadway, New York 13, N. Y.
Astron Corp., 225 Grant Ave., E. Newark, N. J.
Centralab Div. of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.
Condenser Products Co., 7517 N. Clark St., Chicago 26, Ill.
Cornell-Dubilier Electric Corp., South Plainfield, N. J.
Corning Glass Works, Corning, N. Y.
Dumont Electric Corp., 308 Dyckman St., New York, N. Y.
Electrical Reactance Corp., Seneca Ave., Olean, N. Y.
Electro Motive Mfg. Co., Willimantic, Conn.
Erie Resistor Corp., 644 W. 12th St., Erie, Pa.
Filtron Co., Inc., 131–05 Fowler Ave., Flushing, N. Y.
Illinois Condenser Co., 1616 N. Throop St., Chicago, Ill.
Jennings Radio Mfg. Co., 970 McLaughlin Ave., P. O. Box 1278, San Jose 12, Calif.
Johnson Co., E. F., Waseca, Minn.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Pyramid Electric Co., 155 Oxford St., Paterson, N. J.
Sangamo Electric Co., Springfield, Ill.

Ceramics

Sprague Electric Co., North Adams, Mass. ADV. PG. 102.
Standard Coil Products Co., 2329 N. Pulaski Rd., Chicago 39, Ill.
Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.
United Condenser Corp., 337 E. 139th St., New York 54, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

CARBOYS—Glass

Corning Glass Works, Corning, N. Y.
Will Corp., Rochester 3, N. Y.

CARBOYS—Stoneware

Knight, Maurice A., 171 Kelly Ave., Akron, Ohio

CATHETOMETERS

Eberbach Corporation, Ann Arbor, Corp.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

CENTRIFUGES—Clinical

Clay-Adams Co., 141 E. 25th St., New York 10, N. Y.
Custom Scientific Instruments Inc., P. O. Box 170, Arlington, N. J.
International Equipment Co., 1284 Soldiers Field Rd., Boston 35, Mass.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Merco Centrifugal Co., 1045 Sansome St., San Francisco 11, Calif.
Phillips-Drucker, 2245 S. Vandeventer Ave., St. Louis, Mo.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Will Corp., Rochester 3, N. Y.

CENTRIFUGES—Hand Operated

Boekel & Co., Inc., Wm., 509–519 Vine St., Philadelphia 6, Pa.
Clay-Adams Co., 141 E. 25th St., New York 10, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Will Corp., Rochester 3, N. Y.

CENTRIFUGES—Micro

Clay-Adams Co., 141 E. 25th St., New York 10, N. Y.
Custom Scientific Instruments Inc., P. O. Box 170, Arlington, N. J.
International Equipment Co., 1284 Soldiers Field Rd., Boston 35, Mass.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.

CENTRIFUGES—Ultra

Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Specialized Instruments Corp., Belmont, Calif. ADV. PG. 118.

CERAMICS

American Lava Corp., Chattanooga 5, Tenn. ADV. PG. 97.
Centralab, Div. of Globe Union Inc., 900 E. Keefe Ave, Milwaukee 1, Wis.

Chambers

Claycraft Co., Box 866, Columbus, Ohio
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.
Glenco Corp., Metuchen, N. J.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hermetic Seal Products Co., 29–37 S. 6th St., Newark 7, N. J.
Kirchberger & Co., Inc., M., 1425 37th St., Brooklyn 18, N. Y.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Locke Dept., General Electric Co., 1050 Cromwell St., Baltimore 3, Md.
Porcelain Products, Inc., 422 W. Sandusky St., Findlay, Ohio
Star Porcelain Co., 61 Muirhead Ave., Trenton 9, N. J.
Steward Mfg. Co., D. M., E. 36th St., Chattanooga 1, Tenn.
Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.
U. S. Stoneware Co., Akron 9, Ohio
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York, N. Y.

CHAMBERS—Ionization

Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 119.
Nuclear Measurements Co., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Ohmart Corp., 2347 Ferguson Ave., Cincinnati 5, Ohio. ADV. PG. 123.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service Inc., 1417 Solano Ave., Albany, Calif.
Special Instrument Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

CHAMBERS—Ionization, High Pressure

El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.

Chargers

Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.

CHAMBERS—Test

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Bowser Technical Refrigeration Div., Bowser Inc., Terryville, Conn.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Northern-Zaleski, Ltd., Pratt Oval, Glen Cove, N. Y.
Pressed & Welded Steel Products Co., Inc., 38–57 11th St., Long Island City, N. Y.
Tenney Engineering Inc., 26 Avenue B, Newark 5, N. J.
United States Testing Co., Hoboken, N. J. ADV. PG. 103.
York Corp., York, Pa.

CHARGERS—Battery

Electric Service Systems, Inc., 1330 Quincy St., N.E., Minneapolis 13, Minn.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Epco Products, Inc., 2500 Atlantic Ave., Brooklyn 7, N. Y.
Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gerator Corp., 1820 N. Nash St., Arlington, Va.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Kahlenberg Bros. Co., 12th & Monroe Sts., Two Rivers, Wis.
Kellogg Switchboard & Supply Co., 6655 S. Cicero St., Chicago 38, Ill.
Kepco Labs., Inc., 149–14 41st Ave., Flushing, N. Y. ADV. PG. 115.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Mellaphone Corporation, Rochester 2, N. Y.
Opad-Green Co., 71 Warren St., New York, N. Y.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

CHARGERS—Dosimeter

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman, Inc., Arnold O., 1020 Mission St., South Pasadena, Calif.
Cambridge Instrument Co., Inc., 3786 Grand Central Terminal, New York 17, N. Y.
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
General Electric Co., Apparatus Marketing Dept., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Henson Co., Fred C., 3311 E. Colorado St., Pasadena 8, Calif.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 119.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

Chronographs

Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.

CHRONOGRAPHS

Associated Research, Inc., 3758 W. Belmont, Chicago, Ill.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Cinema-Television Ltd., Worsley Bridge Rd., London S. E. 26, England
Electro Medical Lab., Inc., South Woodstock 6, Vt.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y. ADV. PG. 139.

CHRONOSCOPES

American Chronoscope Corp., 316 W. First St., Mt. Vernon, N. Y.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y. ADV. PG. 139.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Standard Electric Time Co., 89 Logan St., Springfield, Mass.

CLAMPS

Chandler & Stedman, 398 Newton St., Waltham 54, Mass.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Humboldt Mfg. Co., 2016 N. Whipple, Chicago, Ill.

CLEANERS—Bottle

Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.

CLEANERS—Vacuum

American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Breuer Electric Mfg. Co., 5100 N. Ravenswood Ave., Chicago 40, Ill.
General Electric Co., Small Appliance Div., 1285 Boston Ave., Bridgeport 2, Conn. ADV. PGS. 75 to 86.
Martindale Electric Co., Hird Ave., Cleveland 7, Ohio

CLEANING REAGENTS

Jasonals Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
Linick Chemical Co., 29 E. Madison St., Chicago 2, Ill.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Will Corp., Rochester 3, N. Y.

CLOTH—Acid & Alkali Resisting

Gordon-Lacey Chemical Products Co., Inc., 57–02 48th St., Maspeth, N. Y.

CLOTHING—Protective

Bullard Co., E. D., 275 Eighth St., San Francisco 3, Calif.
Goodrich Co., B. F., 448 S. Main St., Akron, Ohio

COATINGS—Conductive

Acheson Colloids Corp., Port Huron, Mich.

Columns

Atlas Mineral Products Co., 121 Norman St., Mertztown, Pa.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Irvington Varnish & Insulator Co., 6 Argyle Terrace, Irvington, N. J.
Micro-Circuits Co., New Buffalo, Mich.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.

COLLECTORS—Dust

Aget-Detroit Co., 612 First National Bank Bldg., Ann Arbor, Mich.
American Air Filter Co., Inc., 215 Central Ave., Louisville 8, Ky.
American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Day Co., The, 820 Third Ave., NE, Minneapolis 13, Minn.
Electrovent Fan & Mfg. Co., 812 W. Lake St., Chicago 7, Ill.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., Boston 27, Mass.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Houston Blow Pipe & Sheet Metal Works, P. O. Box 1692, Houston 1, Texas.
Industrial Products Engineering Co., 44–26 Hunter St., Long Island City, N. Y.
Modern Dust Bag Co., 547 Broadway, New York, N. Y.
Northern Blower Co., 6427 Barberton Ave., Cleveland 2, Ohio
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Ruemelin Mfg. Co., 3961 N. Palmer St., Milwaukee, Wis.

COLORIMETERS

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Brociner-Mass Instruments, Inc., 1546 Second Ave., New York 28, N. Y.
Coleman Instruments, Inc., Maywood, Ill.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Hellige, Inc., 3718 Northern Blvd., Long Island City 1, N. Y.
Huggins Laboratories, 734 Hamilton Ave., Menlo Park, Calif.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Klett Mfg. Co., 179 E. 87th St., New York 28, N. Y.
Leitz, Inc., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Photobell Company, 116 Nassau St., New York 7, N. Y.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Will Corp., Rochester 3, N. Y.

COLUMNS—Absorption

Bethlehem Steel Co., Bethlehem, Pa.
Haveg Corp., Newark 6, Delaware
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Pabst Engineering Equipment Co., Inc., Elizabeth N. J.
Radioisotope Application Co., 1843 University Ave. Berkeley 3, Calif.
Struthers-Wells Corp., Warren, Pa.

Columns

U. S. Stoneware Co., Akron 9, Ohio
Will Corp., Rochester 3, N. Y.

COLUMNS—Distilling, Fractionating, etc.

Able Scientific Glass Apparatus Co., 6859 S. Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
American Copper & Brass Works, Inc., Cincinnati 2, Ohio
Blickman, Inc., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 4.
Corning Glass Works, Corning, N. Y.
Glass Engineering Laboratories, Belmont, Calif.
Haveg Corp., Newark 6, Delaware
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Struthers-Wells Corp., Warren, Pa.
U. S. Stoneware Co., Akron 9, Ohio
Will Corp., Rochester 3, N. Y.

COMPARATOR—DENSITOMETER

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Photobell Company, 116 Nassau St., New York 7, N. Y.
Welch Scientific Corp., W. M., 1515 Sedgwick St., Chicago 10, Ill.

COMPARATORS—Hydrogen Ion

LaMotte Chemical Products Co., Towson 4, Md.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Will Corp., Rochester 3, N. Y.

COMPARATORS—Micro Photometer

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

COMPRESSORS

Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 1, Wis.
Beach-Russ Co., 44 Church St., New York 7, N. Y.
Buckeye Air Compressor Co., 414 Littell Ave., Dayton, Ohio
Clark Bros. Co., Inc., Lincoln Ave. & Fifth St., Olean, N. Y.
De Vilbiss Co., 300 Phillips Ave., Toledo, Ohio
Harris, Inc., Machine Works, 61 S. E. Yamhill, Portland, Ore.
Imperial Cantrell Mfg. Co., Jellico, Tenn.
Jay Mfg. Co., Oliver Bldg., Pittsburgh 22, Pa.
Kahlenberg Bros. Co., 12th & Monroe Sts., Two Rivers, Wis.
M. C. Mfg. Co., Lake Orion, Mich.
Ornamental Iron Work Co., 250 E. Crosier St., Akron 11, Ohio
Pelton & Crane Co., 632 Harper Ave., Detroit, Mich.
Trane Co., La Crosse, Wis.
Worthington Pump & Machinery Corp., 426 Worthington Ave., Harrison, N. J.
York Corp., York, Pa.

Containers

CONTAINERS—Acid Proof

Atlas Mineral Products Co., 121 Norman St., Mertztown, Pa.
Bristol Metal Products Corp., Bristol, Tenn.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Electro Chemical Supply & Engineering Co., 750 Broad St., Emmaus, Pa.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 27, Mass.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.
Goodrich Co., B. F., 448 S. Main St., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Haveg Corp., Newark 6, Delaware
Industrial Products Engineering Co., 44–25 Hunter St., Long Island City, N. Y.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
National Lead Co., 111 Broadway, New York 6, N. Y.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
U. S. Stoneware Co., Akron, Ohio
Will Corp., Rochester 3, N. Y.

CONTAINERS—Glass

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Corning Glass Works, Corning, N. Y.
Kimbel Glass Div., O. I. G. Co., Vineland, N. J.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Will Corp., Rochester 3, N. Y.

CONTAINERS—Glass Lined

Pfaudler Co., East Ave. & Clark St., Rochester, N. Y.

CONTAINERS—Lead or Lead Lined

Alpha Metals Inc., 363 Hudson Ave., Brooklyn, N. Y.
Andel & Co., Inc., 5218 N. Kedzie Ave., Chicago, Ill.
Bar-Ray Products Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Bohn Wood Products Co., Route 30 E, Fort Wayne, Ind.
Eldorado Mining & Refining Ltd., Ottawa, Ontario, Canada. ADV. PG. 114.
Metal Products Corp., 48 W. 19th St., Weehawken, N. J.
National Lead Co., 111 Broadway, New York 6, N. Y.
Nuclear Research Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

CONTAINERS—Metal

Aluminum Co. of America, 2156 Gulf Bldg., Pittsburgh, Pa.
Blickman, Inc., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 4.
Bristol Metal Products Corp., Bristol, Tenn.
Bud Radio, Inc., 2118 E. 55th St., Cleveland 3, Ohio
Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., Boston 27, Mass.
Falstrom Co., 7 Falstrom Court, Passaic, N. J.

Containers

General Mixing Equipment Co., 411 N. 3rd St., Philadelphia, Pa.
Harford Metal Products, Inc., P. O. Box 459, Aberdeen, Md.
Hofman Laboratories, Inc., 218 Wright St., Newark 5, N. J.
Industrial Products Engineering Co., 44–25 Hunter St., Long Island City, N. Y.
Kling Metal Spinning Co., 174 Centre St., New York 13, N. Y.
Linde Air Products Co., Unit of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Lyon Metal Products Inc., 10 Montgomery St., Aurora, Ill.
Metal Products Corp., 48 W. 19th St., Weehawken, N. J.
Pfaudler Co., East Ave. & Clark St., Rochester, N. Y.
Pressed & Welded Steel Products Co., Inc., 38–57 11th St., Long Island City, N. Y.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

CONTAINERS—Paper

Canister Co., Inc., Phillipsburg, N. J.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Tarshis Co., N. L., 1133 Broadway, New York, N. Y.

CONTROLLERS—Proportioning

Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
Brookfield Engineering Labs., Inc., Porter St., Stoughton, Mass.
Brooks Rotameter Co., Box A-1347, Lansdale, Pa.
Fielden Instrument Corp., 2920 N. 4th St., Philadelphia 33, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Industrial Control Co., 1462 Straight Path Rd., Wyandanch, N. Y.
Infilco, Inc., P. O. Box 5033, Tucson, Ariz.
Leahy Mfg. Co., East 8th & Alameda, Los Angeles 21, Calif.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Magnetic Amplifiers, Inc., 11–54 44th Drive, Long Island City 1, N. Y.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Ave., Philadelphia 44, Pa.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Servomechanisms, Inc., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 126.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.

CONTROLS—Chemical

Associated Valve & Engineering Co., 1150 W. Marquette Rd., Chicago 21, Ill.
Brooks Rotameter Co., Box A-1347 Lansdale, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Industrial Instruments Inc., 17 Pollack Ave., Jersey City 5, N. J.
Infilco, Inc., P. O. Box 5003, Tucson, Ariz.
Network Mfg. Co., 215 W. 5th St., Bayonne, N. J.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.

CONTROLS—Counting & Sorting

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Berkshire Laboratories, 588 Lexington Rd., Concord, Mass.

Controls

Electrodyne Co., 32 Oliver St., Boston, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Control Company, 1200 Soldiers Field Rd., Boston 34, Mass.
Gorrell & Gorrell, Haworth, N. J.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Magnetic Amplifiers, Inc., 11–54 44th Drive, Long Island City 1, N. Y.
Photobell Company, 116 Nassau St., New York 7, N. Y.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y. ADV. PG. 139.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Ripley Co., Inc., 22 W. First St., Mt. Vernon, N. Y.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.

CONTROLS—Film Thickness

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Fielden Instrument Corp., 2920 N. 4th St., Philadelphia 33, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus 12, Ohio
Photobell Company, 116 Nassau St., New York 7, N. Y.

CONTROLS—Fluid Flow

Air Associates Inc., Teterboro, N. J. ADV. PG. 133.
Alloy Steel Products Co., 1500 W. Elizabeth Ave., Linden, N. J.
Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
Associated Valve & Engineering Co., 1150 W. Marquette Rd., Chicago 21, Ill.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Coral Designs Div., Henry G. Dietz Co., 12–16 Astoria Blvd., Long Island City 2, N. Y.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Controls Co., Glendale 1, Calif.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I.
Infilco, Inc., P. O. Box 5033, Tucson, Ariz.
Kieley & Mueller, Inc., North Bergen, N. J.
Leahy Mfg. Co., East 8th & Alameda, Los Angeles 21, Calif.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Vacuum-Electronic Engineering Co., 756 Third Ave., Brooklyn 32, N. Y. ADV. PG. 128.

CONTROLS—Humidity

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.

Controls

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Controls Co., Glendale 1, Calif.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Minneapolis-Honeywell Regulator Co., Wayne & Roberts Aves., Industrial Div., Philadelphia 44, Pa.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Tagliabue Instruments Div., Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.

CONTROLS—Indicating, Millivoltmeter

Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
General Controls Co., Glendale 1, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
Illinois Testing Labs, Inc., 420 N. LaSalle St., Chicago 10, Ill.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.

CONTROLS—Indicating, Millivoltmeter, Pyrometer

General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
Illinois Testing Labs., Inc., 420 N. LaSalle St., Chicago 10, Ill.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Taco West Corp., 525 N. Noble St., Chicago 22, Ill.
Tagliabue Instruments Div., Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.

CONTROLS—Liquid Level

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
Associated Valve & Engineering Co., 1150 W. Marquette Rd., Chicago 21, Ill.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Coral Designs Div., Henry G. Dietz Co., 12-16 Astoria Blvd., Long Island City 2, N. Y.
Cutler-Hammer, Inc., 412 No. 12th St., Milwaukee 1, Wis.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.

Controls

Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J.
Fielden Instrument Corp., 2920 N. 4th St., Philadelphia 33, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Controls Co., Glendale 1, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Magnetics Inc., 136 Bloomfield Ave., Bloomfield, N. J.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Hofman Laboratories, Inc., 218 Wright St., Newark 5, N. J.
Infilco, Inc., P. O. Box 5033, Tucson, Ariz.
Johnson Corp., 809 Wood St., Three Rivers, Mich.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Keckley Co., O. C., 400 Madison St., Chicago 6, Ill.
Kieley & Mueller, Inc., North Bergen, N. J.
Mercoid Corp., 4201 Belmont Ave., Chicago 41, Ill.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Phoenix Precision Instrument Co., 3803-05 North 5th St., Philadelphia, Pa.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Ripley Co., Inc., 22 W. First St., Mt. Vernon, N. Y.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Tagliabue Instruments Div. of Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thermo Instruments Co., 1066 El Camino Real, Belmont, Calif.

CONTROLS—Motor

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee, Wis.
Allis Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 1, Wis.
American Relay & Controls, Inc., 4901 Fluornoy St., Chicago 44, Ill.
Arrow-Hart & Hegeman Electric Co., 103 Hawthorne St., Hartford, Conn.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Carnine & Bitter, 12 H St., N.E., Washington 2, D. C.
Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Gale Dorothea Mechanisms, 81-01 Broadway, Elmhurst, N. Y.
General Control Company, 1200 Soldiers Field Rd., Boston 34, Mass.
General Controls Co., Glendale 1, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Magnetics Inc., 136 Bloomfield Ave., Bloomfield, N. J.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Industrial Control Co., 1462 Straight Path Rd., Wyandanch, N. Y.
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.

Controls

Magnetic Amplifiers, Inc., 11–54 44th Drive, Long Island City 1, N. Y.
Ohmite Mfg. Co., 4835 W. Flourney St., Chicago 44, Ill.
Rhodes, Inc., M. H., 30 Bartholomew Ave., Hartford Conn.
Robinette Co., W. C., 802 Fair Oaks Ave., South Pasadena, Calif.
Servomechanisms, Inc., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 126.
Small Motors, Inc., 2076 Elston Ave., Chicago 14, Ill.
Ward Leonard Electric Co., 31 South St., Mt. Vernon, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

CONTROLS—Photographic Exposure

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Rhodes, Inc., M. H., 30 Bartholomew Ave., Hartford, Conn.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.

CONTROLS—Pressure

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Aquatrol, Inc., 511 N. Peoria St., Chicago 22, Ill.
Askania Regulator Co., 240 E. Ontario St., Chicago, 11, Ill.
Associated Valve & Engineering Co., 1150 W. Marquette Rd., Chicago 21, Ill.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Coral Designs Div., Henry G. Dietz Co., 12–16 Astoria Blvd., Long Island City 2, N. Y.
Cutler-Hammer, Inc., 4121 No. 112th St., Milwaukee 1, Wis.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford Ill.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gas & Oil Industry Laboratories, Inc., 2 Paine Ave., Irvington 11, N. J.
General Controls Co., Glendale 1, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Keckley Co., O. C., 400 Madison St., Chicago 6, Ill.
Kieley & Mueller, Inc., North Bergen, N. J.
Leahy Mfg. Co., East 8th & Alameda, Los Angeles 21, Calif.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Mercoid Corp., 4201 Belmont Ave., Chicago 41, Ill.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Nageldinger & Son, John, 409 E. 91st St., New York, N. Y.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.

Controls

Servomechanisms, Inc., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 126.
Swartwout Co., 18457 Euclid Ave., Cleveland, Ohio
Tagliabue Instruments Div. of Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

CONTROLS—Remote

Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
Arlington Electric Products Inc., 500 W. 52nd St., New York, N. Y.
Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
Associated Valve & Engineering Co., 1150 Marquette Rd., Chicago 21, Ill.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Brooks Rotameter Co., Box A-1347, Lansdale, Pa.
Carnine & Bitter, 12 H St., N.E., Washington 2, D. C.
Communications Co., Inc., 300 Greco Ave., Coral Gables 34, Fla.
Coral Designs Div., Henry G. Dietz Co., 12-16 Astoria Blvd., Long Island City 2, N. Y.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J.
Elm Laboratories, 18 South Broadway, Dobbs Ferry, N. Y.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gale Dorothea Mechanisms, 81–01 Broadway, Elmhurst, N. Y.
General Controls Co., Glendale 1, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Magnetics Inc., 136 Bloomfield Ave., Bloomfield, N. J.
Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I.
Industrial Control Co., 1462 Straight Path Rd., Wyandanch, N. Y.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Kieley & Mueller, Inc., North Bergen, N. J.
Mercoid Corp., 4201 Belmont Ave., Chicago 41, Ill.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Minnesota Electronics Corp., 97 E. 5th St., St. Paul 1, Minn.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Photobell Company, 116 Nassau St., New York 7, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Robinette Co., W. C., 802 Fair Oaks Ave., South Pasadena, Calif.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Servomechanisms, Inc., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 126.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Vacuum-Electronic Engineering Co., 756 Third Ave., Brooklyn 32, N. Y. ADV. PG. 128.

Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

CONTROLS—Servo

Aeronautical Research Labs., General Mills, Inc., 2010 E. Hennepin Ave., Minneapolis 3, Minn. ADV. PG. 96.
Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
Arlington Electric Products, Inc., 500 W. 52nd St., New York, N. Y.
Arma Corp., 254 36th St., Brooklyn 32, N. Y.
Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J.
Electronic Associates, Inc., Long Branch, N. J.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Ford Instrument Co., 31–10 Thomson Ave., Long Island City, N. Y.
Gaveco Labs., Inc., 2 East End Ave., New York 21, N. Y.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Magnetics Inc., 136 Bloomfield Ave., Bloomfield, N. J.
Industrial Control Co., 1462 Straight Path Rd., Wyandanch, N. Y.
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.
Magnetic Amplifiers, Inc., 11–54 44th Drive, Long Island City 1, N. Y.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Minnnesota Electronics Corp., 97 E. 5th St., St. Paul 1, Minn.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Reeves Instrument Corp., 215 E. 91st St., New York 28, N. Y.
Robinette Co., W. C., 802 Fair Oaks Ave., South Pasadena, Calif.
Servo Corp., of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Servo-Tek Products Co., 4 Godwin Ave., Paterson 1, N. J.
Servomechanisms, Inc., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 126.
Sherron Electronics Co., 1201 Flushing Ave., Brooklyn 6, N. Y.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.

CONTROLS—Specific Gravity

Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.,
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.

CONTROLS—Temperature

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Aquatrol, Inc., 511 N. Peoria St., Chicago 22, Ill.
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Carnine & Bitter, 12 H St., N.E., Washington 11, D. C.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Edison Inc., Thomas A., Instrument Div., West Orange, N. J.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Fenwal, Inc., 120 Pleasant St., Ashland, Mass.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Controls Co., Glendale 1, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Magnetics Inc., 136 Bloomfield Ave., Bloomfield, N. J.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
Hagen Corp., 323 Fourth Ave., Pittsburgh 30, Pa.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Illinois Testing Labs., Inc., 420 N. LaSalle St., Chicago 10, Ill.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Industrial Engineering & Equipment Co., 711 S. Theresa, St. Louis 3, Mo.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Keckley Co., O. C., 400 Madison St., Chicago 6, Ill.
Kieley & Mueller, Inc., North Bergen, N. J.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Macdonald & Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass. ADV. PG. 138.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Mercoid Corp., 4201 Belmont Ave., Chicago 41, Ill.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Partlow Corp., The, 2 Campion Rd., New Hartford, N. Y.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia 30, Pa.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Swartwout Co., 18457 Euclid Ave., Cleveland, Ohio
Taco West Corp., 525 Noble St., Chicago 22, Ill.
Tagliabue Instruments Div. of Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thermo Electric Mfg. Co., 465 Huff, Dubuque, Ia.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Watlow Electric Mfg. Co., 2256 Dickson St., St. Louis, Mo.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.

CONTROLS—Temperature, Precision

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.

Controls

Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Carnine & Bitter, 12 H St., N.E., Washington 2, D. C.
Edison Inc., Thomas A., Instrument Div., West Orange, N. J.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Fenwal, Inc., 120 Pleasant St., Ashland, Mass.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Controls Co., Glendale 1, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Magnetics Inc., 136 Bloomfield Ave., Bloomfield, N. J.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
Illinois Testing Labs., Inc., 420 N. LaSalle St., Chicago 10, Ill.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Keckley Co., O. C., 400 W. Madison St., Chicago 6, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Macdonald & Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass. ADV. PG. 138.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Mercoid Corp., 4201 Belmont Ave., Chicago 41, Ill.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Taco West Corp., 525 N. Noble St., Chicago 22, Ill.
Tagliabue Instruments Div., Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.

CONTROLS—Timing

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
American Chronoscope Corp., 316 W. First St., Mount Vernon, N. Y.
American Communications Corp., 306 Broadway, New York 7, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Berkeley Scientific Co., 6th & Nevin, Richmond, Calif. ADV. PG. 113.
Berkshire Laboratories, P. O. Box 70, Concord Mass.
Carnine & Bitter, 12 H St., N.E., Washington 11, D. C.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio.
Cramer Co., Inc., R. W., Centerbrook, Conn.
Cutler-Hammer, Inc., 412 No. 12th St., Milwaukee 1, Wis.
Edison, Inc., Thomas A., Instrument Div., West Orange, N. J.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Elm Laboratories, 18 South Broadway, Dobbs Ferry, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gale Dorothea Mechanisms, 81-01 Broadway, Elmhurst, N. Y.

Controls

General Control Company, 1200 Soldiers Field Rd., Boston 34, Mass.
General Controls Co., Glendale 1, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gorrell & Gorrell, Haworth, N. J.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Haydon Mfg. Co., Inc., 584 E. Elm St., Torrington, Conn.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Magnetic Amplifiers, Inc., 11-54 44th Drive, Long Island City 1, N. Y.
Marconi Instruments, Ltd., 23-25 Beaver St., New York 4, N. Y.
Paragon Electric Company, Two Rivers, Wisconsin
Partlow Corp., The, 2 Campion Rd., New Hartford, N. Y.
Patterson, Moos & Co., Inc., 32-36 47th Ave., Long Island City 1, N. Y.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Photobell Company, 116 Nassau St., New York 7, N. Y.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y. ADV. PG. 139.
Rhodes Inc., M. H., 30 Bartholomew Ave., Hartford, Conn.
Ripley Co., Inc., 22 W. First St., Mount Vernon, N. Y.
Sangamo Electric Co., Springfield, Ill.
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill. ADV. PG. 136.
Tagliabue Instruments Div. of Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

CONTROLS—Vacuum

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Aquatrol, Inc., 511 N. Peoria St., Chicago 22, Ill.
Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
Associated Valve & Engineering Co., 1150 W. Marquette Rd., Chicago 21, Ill.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Coral Designs Div., Henry G. Dietz Co., 12-16 Astoria Blvd., Long Island City 2, N. Y.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Distillation Products Industries, Rochester 3, N. Y.
Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Controls Co., Glendale 1, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I.
Hastings Instrument Co., Box 1275, Hampton, Va.
High Voltage Engineering Corp., 7 University Rd., Cambridge 38, Mass. ADV. PG. 101.
Kieley & Mueller, Inc., North Bergen, N. J.

Controls

Mercoid Corp., 4201 Belmont Ave., Chicago 41, Ill.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Optical Film Engineering Co., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 140.
Phillips-Drucker, 2245 S. Vandeventer Ave., St. Louis, Mo.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Stokes Machine Co., F. J., Frankford Station P. O., Philadelphia 20, Pa.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Tagliabue Instruments Div. of Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Vacuum-Electronic Engineering Co., 756 Third Ave., Brooklyn 32, N. Y. ADV. PG. 128.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.

CONTROLS—Ventilating Control System

Coral Designs Div., Henry G. Dietz Co., 12–16 Astoria Blvd., Long Island City 2, N. Y.
General Controls Co., Glendale 1, Calif.
Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Mercoid Corp., 4201 Belmont Ave., Chicago 41, Ill.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

COUNTERS—Alpha

Alco Mfg. Co., 4011 Cuming St., Omaha 3, Neb.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Clarkstan Corp., 11921 SW Pico Blvd., Los Angeles 64, Calif.
Eck & Krebs, Inc., 27–09 40th Ave., Long Island City 1, N. Y.
Electronic Products Co., 111 E. Third St., Mount Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Leighton Labs., H. W., 26 Herman St., Glen Ridge, N. J.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass. ADV. PG. 138.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.

Controls

Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Precision Radiation Instruments, 413 W. Jefferson Blvd., Los Angeles 16, Calif.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Special Instrument Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

COUNTERS—Beta

Able Scientific Glass Apparatus Co., 6859 S. Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
Alco Mfg. Co., 4011 Cuming St., Omaha 3, Neb.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Atomic Instrument Co., 84 Massachusettts Ave., Cambridge 39, Mass. ADV. PG. 129.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Berkeley Scientific Co., 6th & Nevin, Richmond, Calif. ADV. PG. 113.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Detectron Co., 5631 Cahuenga Blvd. N. Hollywood, Calif.
Electronic Products Co., 111 E. Third St., Mount Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Leighton Labs., H. W., 26 Herman St., Glen Ridge, N. J.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass. ADV. PG. 138.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.

Counters

Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Precision Radiation Instruments, 413 W. Jefferson Blvd., Los Angeles 16, Calif.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Special Instrument Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

COUNTERS—Crystal Conduction

Patterson, Moos & Co., 32–36 47th Ave., Long Island City 1, N. Y.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

COUNTERS—Electromechanical

Engineering Research Associates, 1902 W. Minnehaha Ave., St. Paul 4, Minn.

COUNTERS—Flow

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Research Equipment & Service, 6054 Woodlawn Ave., Chicago 37, Ill.

Counters

Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

COUNTERS—Gamma

Able Scientific Glass Apparatus Co., 6859 S. Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
Alco Mfg. Co., 4011 Cuming St., Omaha 3, Neb.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Berkeley Scientific Co., 6th & Nevin, Richmond, Calif. ADV. PG. 113.
Cinema-Television Ltd., Worsley Bridge Rd., London S. E., 26, England
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Electronic Products Co., 111 E. Third St., Mount Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Kelley-Koett Instrument Co., 930 York Ave., Cincinnati 14, Ohio
Leighton Labs., H. W., 26 Herman St., Glen Ridge, N. J.
Menlo Research Laboratory, Menlo Park, Calif.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Precision Radiation Instruments, 413 W. Jefferson Blvd., Los Angeles 16, Calif.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radioactive Products Inc., 443 W. Congress St., Detroit 26, Mich.
Raytheon Mfg. Co., Special Tube Section, 55 Chapel St., Newton 58, Mass. ADV. PG. 100.
Special Instrument Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.

Counters

Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

COUNTERS—High Temperature

Electronic Products Co., 111 E. Third St., Mount Vernon, N. Y.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

COUNTERS—Medical Probing

Leighton Labs., H. W., 26 Herman St., Glen Ridge, N. J.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.

COUNTERS—Methane Flow Alpha

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

COUNTERS—Neutron

Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.

Counters

Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

COUNTERS—Proportional

Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Electronic Products Co., 111 E. 3rd St., Mt. Vernon, N. Y.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
Leighton Labs., H. W., 26 Herman St., Glen Ridge, N. J.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

COUNTERS—Radiation

Able Scientific Glass Apparatus Co., 6859 S. Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
Alco Mfg. Co., 4011 Cuming St., Omaha 3, Neb.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electronic Products Co., 111 E. 3rd St., Mt. Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio

Counters

Menlo Research Laboratory, Menlo Park, Calif.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Precision Radiation Instruments, 413 W. Jefferson Blvd., Los Angeles 16, Calif.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137.
Raytheon Mfg. Co., Special Tube Section, 55 Chapel St., Newton 58, Mass. ADV. PG. 100.
Special Instruments Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

COUNTERS—Scintillation

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Berkeley Scientific Co., 6th & Nevin, Richmond, Calif. ADV. PG. 113.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass. ADV. PG. 138.
National Radiac, Inc., 10 Crawford St., Newark 2, N. J. ADV. PG. 136.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.

Crystals

Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

COUNTERS—X-Ray

Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Electronic Products Co., 111 E. Third St., Mt. Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.

CRYSTALS—Scintillation

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
Jasonols Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass. ADV. PG. 138
National Radiac, Inc., 10 Crawford St., Newark 2, N. J. ADV. PG. 136.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Pilot Chemicals, Inc., 47 Felton St., Waltham 54, Mass.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

DECADE BOXES—Capacitance

Cornell-Dubilier Electric Corp., South Plainfield, N. J.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Industrial Instruments, Inc., 17 Pollack Ave., Jersey City 5, N. J.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.

DECADE BOXES—Resistance

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Clarostat Mfg. Co., Inc., Dover, New Hampshire
Daven Co., 191 Central Ave., Newark 4, N. J.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Industrial Instruments, Inc., 17 Pollack Ave., Jersey City 5, N. J.
Shallcross Mfg. Co., 10 Jackson Ave., Collingdale, Pa.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.

DECONTAMINANTS

Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.
Alrose Chemical Co., Box 1294, Providence, R. I.
Atomlab, Inc., 489 Fifth Ave., New York, N. Y.
Bersworth Chemical Co., Waverly St., Framingham, Mass. ADV. PG. 138.
Carbide & Carbon Chemicals Div., Union Carbide & Carbon Corp., 30 East 42nd St., New York 17, N. Y.
Mathieson Chemical Corp., Mathieson Bldg., Baltimore 3, Md.

DEHUMIDIFIERS

Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.
Carbide & Carbon Chemicals Div., Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Clarage Fan Co., 719 Porter St., Kalamazoo, Mich.
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Kellogg Switchboard & Supply Co., 6655 S. Cicero St., Chicago 38, Ill.
Pittsburgh Lectrodryer Corp., P. O. Box 1766, Pittsburgh, Pa.
Remington Air Conditioning Corp., Willey St., Auburn, N. Y.
Trane Co., La Crosse, Wis.
York Corp., York, Pa.

DEMAGNETIZERS

General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Linick Chemical Co., 29 E. Madison St., Chicago 2, Ill.
Permoflux Corp., 4900 W. Grand Ave., Chicago 39, Ill.

DENSITOMETERS

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
American Scientific Co., P. O. Box 1, Highbridge Station, New York 52, N. Y.
Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Photobell Company, 116 Nassau St., New York 7, N. Y.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.

DESSICATORS—Micro

Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.

DESSICATORS—Vacuum

Corning Glass Works, Corning, N. Y.

DETECTORS—Alpha

Alco Mfg. Co., 4011 Cuming St., Omaha 3, Neb.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Electronic Products Co., 111 E. 3rd St., Mt. Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 119.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass. ADV. PG. 138.
Minimax Co., 5905 N. Clark St., Chicago 26, Ill.
National Radiac, Inc., 10 Crawford St., Newark, 2 N. J. ADV. PG. 136.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.

Detectors

Precision Radiation Instruments, 413 W. Jefferson Blvd., Los Angeles 16, Calif.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radioactive Products Inc., 443 W. Congress St., Detroit 28, Mich.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

DETECTORS—Beta

Alco Mfg. Co., 4011 Cuming St., Omaha 3, Neb.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge, Mass. ADV. PG. 129.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman Instrument, Inc., 820 Mission St., South Pasadena, Calif.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Cole Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Electronic Products Co., 111 E. 3rd St., Mt. Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 119.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 33, Mass. ADV. PG. 138.
Minimax Co., 5905 N. Clark St., Chicago 26, Ill.
National Radiac, Inc., 10 Crawford St., Newark 2, N. J. ADV. PG. 136.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Precision Radiation Instruments, 413 W. Jefferson Blvd., Los Angeles 16, Calif.

Detectors

R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Raytheon Mfg. Co., Special Tube Section, 55 Chapel St., Newton 48, Mass. ADV. PG. 100.
Samples Machine Co., A. M., 506 N. Central Ave., Knoxville, Tenn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Radiation Labs., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

DETECTORS—Gamma

Alco Mfg. Co., 4011 Cuming St., Omaha 3, Neb.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Cambridge Instrument Co., Inc., 3786 Grand Central Terminal, New York 17, N. Y.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Electronic Products Co., 111 E. 3rd St., Mt. Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 119.
Linde Air Products Co., Unit of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass. ADV. PG. 138.
Menlo Research Laboratory, Menlo Park, Calif.
Minimax Co., 5905 N. Clark St., Chicago 26, Ill.
National Radiac, Inc., 10 Crawford St., Newark 2, N. J. ADV. PG. 136.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.

Detectors

Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments, Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Precision Radiation Instruments, 413 W. Jefferson Blvd., Los Angeles 16, Calif.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill., ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Raytheon Mfg. Co., Special Tube Section, 55 Chapel St., Newton 58, Mass. ADV. PG. 100.
Samples Machine Co., A. M., 506 N. Central Ave., Knoxville, Tenn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Radiation Labs., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

DETECTORS—Hazardous or Poisonous Gas

Cambridge Instrument Co., Inc., 3786 Grand Central Terminal, New York 17, N. Y.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.

DETECTORS—Leak

Davis Emergency Equipment Co., 252 Halleck St., Newark, N. J.
Fisher Research Laboratory, Inc., 1961–63–65 University Ave., Palo Alto, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Highside Chemicals Co., 10 Colfax Ave., Clifton, N. J.
Menlo Research Laboratory, Menlo Park, Calif.
National Research Corp., 70 Memorial Drive, Cambridge 42, Mass. ADV. PGS. 94, 95.
Optical Film Engineering Co., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 140.
Radio Corp. of America, RCA Victor Div., Tube Dept., 415 S. Fifth St., Harrison, N. J. ADV. PGS. 91, 106, 137.
Vacuum-Electronic Engineering Co., 756 Third Ave., Brooklyn 32, N. Y. ADV. PG. 126.

DETECTORS—Neutron

Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Cambridge Instrument Co., Inc., 3786 Grand Central Terminal, New York 17, N. Y.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.

Detergents

Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill., ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

DETECTORS—X-Ray

Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 119.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass. ADV. PG. 138.
Menlo Research Laboratory, Menlo Park, Calif.
Minimax Co., 5905 N. Clark St., Chicago 26, Ill.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

DETERGENTS

Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.
Alrose Chemical Co., Box 1294, Providence, R. I.

Distillation Equipment

Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Linick Chemical Co., 29 E. Madison St., Chicago 2, Ill.

DISTILLATION EQUIPMENT

American Copper & Brass Works, Inc., Cincinnati 2, Ohio
Barnstead Still & Sterilizer Co., 222 Lanesville Terrace, Forest Hills, Boston 31, Mass.
Corning Glass Works, Corning, N. Y.
Eck & Krebs, Inc., 27–09 40th Ave., Long Island City 1, N. Y.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Illinois Water Treatment Co., 858 Cedar St., Rockford, Ill.
Pfaudler Co., East Ave. & Clark St., Rochester, N. Y.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Stokes Machine Co., F. J. Frankford Station P. O., Philadelphia 20, Pa.
Struthers-Wells Corp., Warren, Pa.
Will Corp., Rochester 3, N. Y.

DOSIMETERS

Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman, Inc., Arnold O., 1020 Mission St., South Pasadena, Calif.
Cambridge Instrument Co., Inc., 3786 Grand Central Terminal, New York 17, N. Y.
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Clarkstan Corp., 11921 SW Pico Blvd., Los Angeles 64, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 119.
Menlo Research Laboratory, Menlo Park, Calif.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
St. John X-Ray Laboratory, Califon, N. J.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. **ADV. PG. 119.**
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

ELECTRICAL TESTING & INDICATING EQUIPMENT

(a) Ammeters
(b) Ammeters, a-c Clamp on
(c) Ammeters, d-c Portable
(d) Microammeters

Electrical Testing Equipment

(e) Micro-Microammeters, Electronic
(f) Milliammeters
(g) Voltmeters
(h) Voltmeters, Electronic

Associated Research, Inc., 3758 W. Belmont, Chicago, Ill. a-b-c-f-g
Audio Instrument Co., Inc., 133 W. 14th St., New York 11, N. Y. h
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England a-c-d-e-f-g-h
Ballantine Laboratories, Inc., Boonton, N. J. h
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif. d-e-h
Beta Electric Corp., 333 E. 103rd St., New York 29, N. Y. e-g
Carnine & Bitter, 12 H. St., N.E., Washington 2, D. C. h
Communication Measurement Lab., Inc., 120 Greenwich St., New York 6, N. Y. a-c
Daven Co., 191 Central Ave., Newark 4, N. J. h
DeJur-Amsco Corp., 45–01 Northern Blvd., Long Island City 1, N. Y. a-d-f-g
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass. h
Electric & Musical Industries Ltd., Hayes, Middlesex, England h
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y. a-b-c-f-g-h
Electronic Measurements Co., Red Bank, N. J. h
Ferranti Electric Inc., 30 Rockefeller Plaza, New York 20, N. Y. g
Fluke Engineering Co., John, Box 755, Springdale, Conn. a-h
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y. h
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86. a-b-c-d-e-f-g
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. g-h
Industrial Control Co., 1462 Straight Path Rd., Wyandanch, N. Y. e-h
Instrument Electronics Corp., 104 W. Jefferston St., Falls Church, Va. h
Instrument Laboratories, 315 W. Walton Place, Chicago, Ill. a-c-d-f-g
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y. h
International Instruments, Inc., P. O. Box 2954 New Haven 15, Conn. a-c-d-f-g
Keithley Instruments, 3868 Carnegie Ave., Cleveland, Ohio e-h
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, e-h
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass. ADV. PG. 138. • d
Manning, Maxwell & Moore, Inc., Stratford, Conn. d-f-g
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y. h
Marion Electrical Instrument Co., Manchester, N. H. ADV. PG. 124. a-d-f-g
Martindale Electric Co., Hird Ave., Cleveland 7, Ohio b-c-g
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa. e-f-h
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y. h
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y. h
Precision Apparatus Co., Inc., 92–27 Horace Harding Blvd., Elmhurst, N. Y. h
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y. a
Radio Corp. of America, RCA Victor Div., Tube Dept., 415 S. Fifth St., Harrison, N. J. ADV. PGS. 91, 106, 137. a-h
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass. c-d-f-g

Electro-Analyzers

Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa. a-c-d-f-g
Sierra Electronic Corp., San Carlos, Calif. h
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill. a-c-d-f-g-h
Southwestern Industrial Electronic Co., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas e-h
Spellman Television Co., Inc., 3029 Webster Ave., Bronx 67, N. Y. ADV. PG. 121. g
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y. g-h
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio a-c-d-f-g-h
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa. a-g
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill. a-d-f-g
Western Electro Acoustic Labs., 204 S. Beverly Drive, Beverly Hills, Calif. h
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif. e
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa. a-c-d-f-g
Weston Electrical Instrument Co., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135. a-b-c-d-e-f-g-h
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill. a-g

ELECTRO-ANALYZERS

Eberbach Corporation, Ann Arbor, Mich.
Instrument Laboratories, 315 W. Walton Place, Chicago, Ill.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Western Electro Acoustic Labs., 204 S. Beverly Drive, Beverly Hills, Calif.
Will Corp., Rochester 3, N. Y.

ELECTROLYTIC OUTFIT, MICRO

Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Weston Electrical Instrument Co., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.

ELECTROMETERS—Vibrating Reed

Applied Physics Corp., 362 W. Colorado St., Pasadena 1, Calif.
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Cole, Ltd., E. K. Electronics Div., Malmesbury, Wiltshire, England
Furst Electronics, 20 Jefferson, Chicago 6, Ill.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.

FANS—Cooling

Air Controls Inc., 2312 Superior Ave., Cleveland 14, Ohio
Chelsea Fan & Blower Co., Inc., 639 South Ave., Plainfield, N. J.
Commercialaire, Inc., 302 Pacific St., Brooklyn 2, N. Y.
Eastern Air Devices, Inc., 585 Dean St., Brooklyn 17, N. Y.
Electrovent Fan & Mfg. Co., 812 W. Lake St., Chicago 7, Ill.
Fasco Industries, Inc., Rochester 2, N. Y.
General Electric Co., Small Appliance Div., 1285 Boston Ave., Bridgeport 2, Conn. ADV. PGS. 75 to 86.
Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, Ill.

Filter Presses

Industrial Products Engineering Co., 44–25 Hunter St., Long Island City, N. Y.
International Engineering, Inc., 1200 Bolander Ave., Dayton, Ohio
Moore Co., Marceline, Mo.
Rotron Mfg. Co., Inc., 7 Schoonmaker Lane, Woodstock, N. Y.
Trane Co., La Crosse, Wis.
Western Blower Co., 1800 Airport Way, Seattle, Wash.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

FILTER CLOTH—Cotton

Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Filtration Engineers, Inc., Filtration Fabrics Div., 155 Oraton St., Newark 4, N. J.
Independent Filter Press, 230 48th St., Brooklyn, N. Y.
Modern Dust Bag Co., 547 Broadway, New York, N. Y.
Shriver & Co., Inc., 808 Hamilton St., Harrison, N. J.

FILTER CLOTH—Metallic

Chase Brass & Copper Co., Waterbury 20, Conn.
Metal Textile Corp., 647 E. First Ave., Roselle, N. J.
Newark Wire Cloth Company, 351 Verona Ave., Newark 4, N. J.
Roebling's Sons Co., John A., 640 S. Broad St., Trenton 2, N. J.

FILTER CLOTH—Synthetic Fibre

Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Filtration Engineers, Inc., Filtration Fabrics Div., 155 Oraton St., Newark 4, N. J.
Independent Filter Press, 230 48th St., Brooklyn, N. Y.
Modern Dust Bag Co., 647 Broadway, New York, N. Y.
Shriver & Co., Inc., 808 Hamilton St., Harrison, N. J.
Varnitron Co., 416 N. Varney St., Burbank, Calif.

FILTER DISKS

Cellulo Co., Sandusky, Ohio
Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Infilco, Inc., P. O. Box 5033, Tucson, Ariz.
Metal Textile Corp., 647 E. First Ave., Roselle, N. J.

FILTER PAPER

Angel & Co., Inc., H. Reeve, 52 Duane St., New York, N. Y.
Cellulo Co., Sandusky, Ohio
Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Eaton-Dikeman Co., Mount Holly Springs, Pa.
Industrial Products Engineering Co., 44–25 Hunter St., Long Island City, N. Y.
Leitz, Inc., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
Modern Dust Bag Co., 547 Broadway, New York, N. Y.
Shriver & Co., Inc., 808 Hamilton St., Harrison, N. J.
Will Corp., Rochester 3, N. Y.

FILTER PRESSES—Laboratory

Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Independent Filter Press, 230 48th St., Brooklyn, N. Y.
Shriver & Co., Inc., 808 Hamilton St., Brooklyn, N. Y.
Will Corp., Rochester 3, N. Y.

FILTERS—Air

American Air Filter Co., Inc., 215 Central Ave., Louisville 8, Ky.
Cambridge Corp., 350 S. Geddes St., Syracuse, N. Y.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Day Co., 820 3rd Ave., NE, Minneapolis 13, Minn.
De Vilbiss Co., 300 Philips Ave., Toledo, Ohio
Gas & Oil Industry Laboratories, Inc., 2 Paine Ave., Irvington 11, N. J.
Independent Filter Press, 230 48th St., Brooklyn, N. Y.
Metal Textile Corp., 647 E. First Ave., Roselle, N. J.
Modern Dust Bag Co., 547 Broadway, New York, N. Y.
Trion, Inc., 1000 Island Ave., McKees Rocks, Pa.
Western Blower Co., 1800 Airport Way, Seattle 66, Wash.

FLOORING—Asphalt

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Beck & Sons, Inc., 300 E. 20th St., New York 3, N. Y.
Flintkote Co., 30 Rockefeller Plaza, New York 30, N. Y.
Johns-Manville, 22 E. 40th St., New York 16, N. Y.

FLUROMETERS

Coleman Instruments, Inc., Maywood, Ill.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Will Corp., Rochester 3, N. Y.

FLUXMETERS

General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Marion Electrical Instrument Co., Manchester, N. H. ADV. PG. 124.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill., ADV. PG. Inside Back Cover.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Varian Associates, 990 Varian St., San Carlos, Calif.

FUME HOODS

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Blickman, Inc., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 4.
Bristol Metal Products Corp., Bristol, Tenn.
Day Co., The, 820 Third Ave., NE, Minneapolis 13, Minn.
Electrovent Fan & Mfg. Co., 812 W. Lake St., Chicago 7, Ill.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Falstrom Co., 7 Falstrom Court, Passaic, N. J.
Haveg Corp., Newark 6, Delaware
Industrial Products Engineering Co., 44–25 Hunter St., Long Island City, N. Y.
Laboratory Construction Co., 1113–1115 Holmes St., Kansas City, Mo.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Sheldon Equipment Co., E. H., Muskegon, Mich.

FURNACES—Combustion, High Temperature

Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
Hones, Inc., Charles A., 122 S. Grand Ave., Baldwin, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Will Corp., Rochester 3, N. Y.

FURNACES—Electric

Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
Harper Electric Furnace Corp., 39 River Rd., Buffalo, N. Y.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Thermo Electric Mfg. Co., 465 Huff, Dubuque, Iowa
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
White Dental Mfg. Co., S. S., 10 E. 40th St., New York, N. Y.
Will Corp., Rochester 3, N. Y.

FURNACES—Laboratory

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Electronic Engineering Corp., 624 Ridge Rd., Lyndhurst, N. J.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
Hones, Inc., Charles A., 122 S. Grand Ave., Baldwin, N. Y.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.
Sjostrom Co., John E., 1715 N. Tenth St., Philadelphia 22, Pa.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.
Thermo Electric Mfg. Co., 465 Huff, Dubuque, Iowa
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.

Furnaces

Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Will Corp., Rochester 3, N. Y.

FURNACES—Low Temperature

Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Hones, Inc., Charles A., 122 S. Grand Ave., Baldwin, N. Y.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

FURNACES—Microcombustion

Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Will Corp., Rochester 3, N. Y.

FURNACES—Muffle

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
Hones, Inc., Charles A., 122 S. Grand Ave., Baldwin, N. Y.
Thermo Electric Mfg. Co., 465 Huff, Dubuque, Iowa
Thomas Co, Arthur H., W. Washington Square, Philadelphia 5, Pa.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Will Corp., Rochester 3, N. Y.

FURNITURE & CONSTRUCTION MATERIALS

ADHESIVES—Waterproof & Corrosion Proof

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Bishop Mfg. Co., 10 Canfield Rd., Cedar Grove, N. J. ADV. PG. 139.
Borden Co., Chemical Div., 350 Madison Ave., New York 17, N. Y.
Carboline Co., 7603 Forsythe Blvd., St. Louis 5, Mo.
Devoe & Raynolds Co., Inc., 787 First Ave., New York, N. Y.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Goodrich Co., B. F., 448 S. Main St., Akron, Ohio
Hamilton Kent Mfg. Co., Kent, Ohio
Irvington Varnish & Insulator Co., 6 Argyle Terrace, Irvington, N. J.
Lasting Products Co., 202 S. Franklintown Rd., Baltimore 23, Md.
Mastic Tile Corp. of America, Newburgh, N. Y.
Monsanto Chemical Co., 1700 S. Second St., St Louis 4, Mo.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Polymer Industries Inc., 1108 30th Ave., Astoria, N. Y.
Sauereisen Cements Co., Sauereisen Bldg., Pittsburgh 15, Pa.

Furniture & Construction Materials

U. S. Plywood Corp., 55 W. 44th St., New York 18, N. Y.

BENCHES

Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Bohn Wood Products Co., Route 30 E, Fort Wayne, Ind.
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., New York, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Harford Metal Products, Inc., P. O. Box 459, Aberdeen, Md.
Kewaunee Mfg. Co., 5083 S. Center St., Adrian, Mich. ADV. PG. 131.
Laboratory Furniture Co., Inc., Mineola, N. Y.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Ornamental Iron Works Co., 250 E. Crosier St., Akron 11, Ohio
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Sheldon Equipment Co., E. H., Muskegon, Mich.
Technical Ply-Woods, 228 N. LaSalle St., Chicago, Ill.

BRACKETS

Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Gaveco Labs., Inc., 2 East End Ave., New York 21, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.

BRICK—Acid Resisting

Acme Brick Co., Fort Worth 2, Texas
Atlas Mineral Products Co., 121 Norman St., Mertzman, Pa.
Ceilcote Co., 4832 Ridge Rd., Cleveland, Ohio
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Kraftile Co., Niles, Calif.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
United Materials & Richmond Brick Co., Ltd., Pt. Richmond, Calif.
U. S. Stoneware Co., Akron 9, Ohio

CABINETS—Drying

Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., New York, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Laboratory Furniture Co., Inc., Mineola, N. Y.
Metal Products Corp., 48 W. 19th St., Weehawken, N. J.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.

CABINETS—Instrument

Blickman, Inc., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 4.
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., New York, N. Y.
Cole Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England

Furniture & Construction Materials

Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Falstrom Co., 7 Falstrom Court, Passaic, N. J.
Imhof, Ltd., Alfred, 112 New Oxford St., London, W. C. 1.
Kewaunee Mfg. Co., 5083 S. Center St., Adrian, Mich. ADV. PG. 131.
Laboratory Furniture Co., Inc., Mineola, N. Y.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.

CABINETS—Laboratory

Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Blickman, Inc., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 4.
Bowser Technical Refrigeration Div., Bowser Inc., Terryville, Conn.
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., New York, N. Y.
Buttling-Padgett Co., Inc., 830 Whittier, New York, N. Y.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South, Boston 23, Mass.
Harford Metal Products, Inc., P. O. Box 459, Aberdeen, Md.
Kewaunee Mfg. Co., 5083 S. Center St., Adrian, Mich. ADV. PG. 131.
Laboratory Furniture Co., Inc., Mineola, N. Y.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Pressed & Welded Steel Products Co., Inc., 38–57 11th St., Long Island City, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.

CEMENTS—Acid Proof

Andel & Co., Inc., 5218 N. Kedzie Ave., Chicago, Ill.
Atlas Mineral Products Co., 121 Norman St., Mertztown, Pa.
Borden Co., Chemical Div., 350 Madison Ave., New York 17, N. Y.
Carboline Co., 7603 Forsythe Blvd., St. Louis 5, Mo.
Ceilcote Co., 4832 Ridge Rd., Cleveland, Ohio
Electro Chemical Supply & Engineering Co., 750 Broad St., Emmaus, Pa.
Haveg Corp., Newark 6, Delaware
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Lasting Products Co., 202 S. Franklintown Rd., Baltimore 23, Md.
Linick Chemical Co., 29 E. Madison St., Chicago 2, Ill.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Sauereisen Cements Co., Sauereisen Bldg., Pittsburgh 15, Pa.
U. S. Stoneware Co., Akron 9, Ohio
Varnitron Co., 416 N. Varney St., Burbank, Calif.

COATINGS—Protective

Acheson Colloids Corp., Huron, Mich.
American Phenolic Corp., 1830 S. 54th Ave., Chicago 50, Ill. ADV. PG. 140.

Furniture & Construction Materials

American Pipe & Construction Co., Amercoat Div., Los Angeles 54, Calif.
Arco Co., The, 7301 Bessemer Ave., Cleveland 27, Ohio
Atlas Mineral Products Co., 121 Norman St., Mertztown, Pa.
Bishop Mfg. Corp., 10 Canfield Rd., Cedar Grove, N. J. ADV. PG. 139.
Carboline Co., 7603 Forsythe Blvd., St. Louis 5 Mo
Ceilcote Co., 4832 Ridge Rd., Cleveland, Ohio
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Corrosite Corp., Chrysler Bldg., New York 17, N. Y.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Emerson & Cuming Co., 126 Massachusetts Ave., Boston 15, Mass.
General Electric Co., Chemical Div., Pittsfield, Mass. ADV. PGS. 75 to 86.
Goodrich Co., B. F., 448 S. Main St., Akron, Ohio
Glidden Co., 11001 Madison Ave., Cleveland 2, Ohio
Gordon-Lacey Chemical Products Co., Inc., 57–02 48th St., Maspeth, N. Y.
Hamilton Kent Mfg. Co., Kent, Ohio
Horn Co., Inc., A. C., 10th St. & 44th Ave., Long Island City 1, N. Y.
Irvington Varnish & Insulator Co., 6 Argyle Terrace, Irvington, N. J.
Knight Maurice A., 171 Kelly Ave., Akron, Ohio
Lasting Products Co., 202 S. Franklintown Rd., Baltimore 23, Md.
Maas & Waldstein Co., 438 Riverside Ave., Newark 4, N. J.
Mitchell-Rand Insulation Co., Inc., 51 Murray St., New York 7, N. Y.
Monsanto Chemical Co., 1700 S. Second St., St. Louis 4, Mo.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Ornamental Iron Work Co., 250 E. Crosier St., Akron 11, Ohio
Owens Corning Fiberglas Corp., 16 E. 56th St., New York 22, N. Y.
Polymer Industries Inc., 1108 30th Ave., Astoria N. Y.
Sauereisen Cements Co., Sauereisen Bldg., Pittsburgh 15, Pa.
United Chromium, Inc., 100 East 42nd St., New York, N. Y.
U. S. Stoneware Co., Akron 9, Ohio
Varnitron Co., 416 N. Varney St., Burbank, Calif.
Zophar Mills, Inc., 112–130 26th St., Brooklyn 32, N. Y.

COATINGS—Strippable

Arco Co., The, 7301 Bessemer Ave., Cleveland 27, Ohio
Atlas Mineral Products Co., 121 Norman St., Mertztown, Pa.
Bishop Mfg. Corp., 10 Canfield Rd., Cedar Grove, N. J. ADV. PG. 139.
Carboline Co., 7603 Forsythe Blvd., St. Louis 5 Mo.
Ceilcote Co., 4832 Ridge Rd., Cleveland, Ohio
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Corrosite Corp., Chrysler Bldg., New York 17, N. Y.
General Electric Co., Chemical Div., Pittsfield, Mass. ADV. PGS. 75 to 86.
Glidden Co., 11001 Madison Ave., Cleveland 2, Ohio
Lasting Products Co., 202 S. Franklintown Rd., Baltimore 23, Md.
Polymer Industries Inc., 1108 30th Ave., Astoria, N. Y.
U. S. Stoneware Co., Akron 9, Ohio
Varnitron Co., 416 N. Varney St., Burbank, Calif.

DESKS—Laboratory

Blickman, Inc., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 4.

Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., New York, N. Y.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Laboratory Furniture Co., Inc., Mineola, N. Y.
Lyon Metal Products Inc., 10 Montgomery St., Aurora, Ill.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Moore Co., The, Marceline, Mo.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.

FANS—Exhaust

Amercian Machine Products Co., Marshalltown, Iowa
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Chelsea Fan & Blower Co., Inc., 639 South Ave., Plainfield, N. J.
Commercialaire, Inc., 302 Pacific St., Brooklyn 2, N. Y.
De Vilbiss Co., 300 Phillips Ave., Toledo, Ohio
Electric Blower Co., 350 Atlantic Ave., Boston, Mass.
Electrovent Fan & Mfg. Co., 812 W. Lake St., Chicago 7, Ill.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Fasco Industries, Inc., Rochester 2, N. Y.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.
Haveg Corp., Newark 6, Delaware
Houston Blow Pipe & Sheet Metal Works, P. O. Box 1692, Houston 1, Texas
Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, Ill.
International Engineering, Inc., 1200 Bolander Ave., Dayton, Ohio
Iona Ventilator Co., Inc., 2829 W. Dauphin St., Philadelphia, Pa.
Nelson, Herman, Div. American Air Filter Co., Inc., Moline, Ill.
Rotron Mfg. Co., Inc., 7 Schoonmaker Lane, Woodstock, N. Y.
Ruemelin Mfg. Co., 3961 N. Palmer St., Milwaukee, Wis.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Trane Co., La Crosse, Wis.
Western Blower Co., 1800 Airport Way, Seattle 66, Wash.
Western Engineering & Mfg. Co., E. Washington & Staunton, Los Angeles, Calif.

FLOORING—Acid-proof

Amercican Mosaic & Tile Co., 331 E. Broadway, Louisville, Ky.
Atlas Mineral Products Co., 121 Norman St., Mertztown, Pa.
Carboline Co., 7603 Forsythe Blvd., St. Louis 5, Mo.
Ceilcote Co., 4832 Ridge Rd., Cleveland, Ohio
Electro Chemical Supply & Engineering Co., 750 Broad St., Emmaus, Pa.
Goodyear Tire & Rubber Co., Akron, Ohio
Haveg Corp., Newark 6, Delaware
Horn Co., Inc., A. C., 10th St. & 44th Ave., Long Island City 1, N. Y
Johns-Manville, 22 E 40th St., New York 16, N. Y.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Kraftile Co., Niles, Calif.
Lasting Products Co., 202 S. Franklintown Rd., Baltimore 23, Md.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Sauereisen Cements Co., Sauereisen Bldg., Pittsburgh 15, Pa.
U. S. Stoneware Co., Akron 9, Ohio

Furniture & Construction Materials

FURNITURE—Laboratory

Blickman, Inc., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 4.
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., New York, N. Y.
Buttling-Padgett Co., Inc., 830 Whittier, New York, N. Y.
Doehler Metal Furniture Co., Inc., 194 Lexington Ave., New York, N. Y.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Gold Seal Mfg. Co., 1230 W. Kinzie St., Chicago 22, Ill.
Kewaunee Mfg. Co., 5083 S. Center St., Adrian, Mich. ADV. PG. 131.
Laboratory Furniture Co., Inc., Mineola, N. Y.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Peterson & Co., Inc., Leonard, 1222 Fullerton Ave., Chicago 14, Ill.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Sheldon Equipment Co., E. H., Muskegon 82, Mich.
Southern Desk Co., Box 630, Hickory, N. C.

PAINTS—Protective

Arco Co., The, 7301 Bessemer Ave., Cleveland 27, Ohio
Ceilcote Co., 4832 Ridge Rd., Cleveland, Ohio
Corrosite Corp., Chrysler Bldg., New York 17, N. Y.
Devoe & Raynolds Co., Inc., 787 First Ave., New York, N. Y.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Glidden Co., 11001 Madison Ave., Cleveland 2, Ohio
Gordon-Lacey Chemical Products Co., Inc., 57-02 48th St., Maspeth, N. Y.
Horn Co., Inc., A. C., 10th St. & 44th Ave., Long Island City 1, N. Y.
Howe & French, Inc., 99 Broad St., Boston 10, Mass.
Irvington Varnish & Insulator Co., 6 Argyle Terrace, Irvington, N. J.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Lasting Products Co., 202 S. Franklintown Rd., Baltimore 23, Md.
Maas & Waldstein Co., 438 Riverside Ave., Newark 4, N. J.
Mitchell-Rand Insulation Co., Inc., 51 Murray St., New York 7, N. Y.
Monsanto Chemical Co., 1700 S. Second St., St. Louis 4, Mo.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Ornamental Iron Work Co., 250 E. Crosier St., Akron 11, Ohio
Sauereisen Cements Co., Sauereisen Bldg., Pittsburgh 15, Pa.
United Chromium, Inc., 100 East 42nd St., New York, N. Y.
U. S. Stoneware Co., Akron 9, Ohio
Varnitron Co., 416 N. Varney St., Burbank, Calif.
Will Corp., Rochester 3, N. Y.

PANELS & WALLBOARD—Pressed Wood

Aetna Plywood & Veneer Co., 1738 N. Elston Ave., Chicago 22, Ill.
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Technical Ply-Woods, 228 N. LaSalle St., Chicago, Ill.
U. S. Plywood Corp., 55 W. 44th St., New York 18, N. Y.
Woodall Industries, Inc., Laurel, Miss.

Furniture & Construction Materials

PLYWOOD—Metal-Clad

Andel & Co., Inc., 5218 N. Kedzie Ave., Chicago, Ill.
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Keller Products, Inc., Manchester, N. H.
Ornamental Iron Work Co., 250 E. Crosier St., Akron 11, Ohio
Technical Ply-Woods, 228 N. LaSalle St., Chicago, Ill.
U. S. Plywood Corp., 55 W. 44th St., New York 18, N. Y.

SINKS—Laboratory

Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Blickman, Inc., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 4.
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., Brooklyn, N. Y.
Buttling-Padgett Co., Inc., 830 Whittier, New York, N. Y.
Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Laboratory Construction Co., 1113–1115 Holmes St., Kansas City, Mo.
Laboratory Furniture Co., Inc., Mineola, N. Y.
Metal Products Corp., 48 W. 19th St., Weehawken, N. J.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Pressed & Welded Steel Products Co., Inc., 38–57 11th St., Long Island City, N. Y.
U. S. Stoneware Corp., Akron 9, Ohio

TABLE TOPS—Laboratory

Bache & Co., Semon, 636 Greenwich St., New York 14, N. Y.
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Blickman, Inc., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 4.
Bristol Metal Products Corp., Bristol, Tenn.
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., Brooklyn, N. Y.
Buttling-Padgett Co., Inc., 830 Whittier, New York, N. Y.
Doehler Metal Furniture Co., Inc., 194 Lexington Ave., New York, N. Y.
Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Keller Products, Inc., Manchester, N. H.
Laboratory Furniture Co., Inc., Mineola, N. Y.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Ornamental Iron Work Co., 250 E. Crosier St., Akron 11, Ohio
Pressed & Welded Steel Products Co., Inc., 38–57 11th St., Long Island City, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Saran Lined Pipe Co., Detroit 2, Mich.
Standard Coated Products, 350 Fifth Ave., New York 1, N. Y.
U. S. Plywood Corp., 55 W. 44th St., New York 18, N. Y.
Woodall Industries, Inc., Laurel, Miss.

Gages

TILE—Asphalt

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Beck & Sons, Inc., 355 E. 20th St., New York 3, N. Y.
Flintkote Co., 30 Rockefeller Plaza, New York 30, N. Y.
Johns-Manville, 22 E. 40th St., New York 16, N. Y.
Lasting Products Co., 202 Franklintown Rd., Baltimore 23, Md.

TILE—Ceramic

See Flooring, Acid-proof.

TILE—Rubber

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Beck & Sons, Inc., 355 E. 20th St., New York 3, N. Y.
Lasting Products Co., 202 Franklintown Rd., Baltimore 23, Md.

VENTILATORS

Accurate Sheet Metal & Mfg. Works, 2336–38 Milwaukee Ave., Chicago 47, Ill.
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Commercialaire, Inc., 302 Pacific St., Brooklyn 2, N. Y.
Electrovent Fan & Mfg. Co., 812 W. Lake St., Chicago 7, Ill.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Iona Ventilator Co., Inc., 2829 W. Dauphin St., Philadelphia, Pa.
Nelson, Herman, Div., American Air Filter Co., Moline, Ill.
Ornamental Iron Work Co., 250 E. Crosier St., Akron 11, Ohio
Standard Ventilator Co., Lewisburg, Pa.
Swartwout Co., 18457 Euclid Ave., Cleveland, Ohio
Trane Co., La Crosse, Wis.
United States Air Conditioning Corp., Como Ave. SE at 33rd, Minneapolis 14, Minn.
Western Engineering & Mfg. Co., E. Washington & Staunton, Los Angeles, Calif.

GAGES—Ionization

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Distillation Products Industries, Rochester 3, N. Y.
Eitel-McCullough, Inc., San Bruno, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
High Voltage Engineering Corp., 7 University Rd., Cambridge 38, Mass. ADV. PG. 101.
Herbach & Rademan Inc., 522 Market St., Philadelphia 6, Pa.
National Research Corp., 70 Memorial Drive, Cambridge 42, Mass. ADV. PGS. 94, 95.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137.
Radio Corp. of America, RCA Victor Div., Tube Dept., 415 S. Fifth St., Harrison, N. J. ADV. PGS. 91, 106, 137.
Universal X-Ray Products Inc., 1140 N. Western Ave., Chicago 22, Ill.

GAGES—McLeod

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

Gages

Distillation Products Industries, Rochester 3, N. Y.
Eck & Krebs, Inc., 27–09 40th Ave., Long Island City 1, N. Y.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

GAGES—Pirani

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Distillation Products Industries, Rochester 3, N. Y.
Eisler Engineering Co., 760 S. 13th St., Newark, N. J.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Universal X-Ray Products Inc., 1140 N. Western Ave., Chicago 22, Ill.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

GAGES—Thickness, Radioactive

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus 12, Ohio
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

GAGES—Vacuum

American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Distillation Products Industries, Rochester 3, N. Y.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Hastings Instrument Co., Box 1275, Hampton, Va.
Keckley Co., O. C., 400 W. Madison St., Chicago 6, Ill.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Marsh Instrument Co., Skokie, Ill.
National Research Corp., 70 Memorial Drive, Cambridge 42, Mass. ADV. PGS. 94, 95.
National Union Radio Corp., 350 Scotland Rd., Orange, N. J.
Optical Film Engineering Co., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 140.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia 30, Pa.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137.
Stokes Machine Co., F. J., Frankford Station P. O., Philadelphia 20, Pa.
Tagliabue Instruments Div. of Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.

Gaskets

Universal X-Ray Products Inc., 1140 N. Western Ave., Chicago 22, Ill.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

GALVANOMETERS

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Berndt-Bach, Inc., 7377 Beverly Rd., Los Angeles 36, Calif.
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
G-M Laboratories, Inc., 4313 N. Knox Ave., Chicago 41, Ill.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Hathaway Instrument Co., 1315 S. Clarkson St., Denver 10, Colo.
Heiland Research Corp., 130 E. 5th Ave., Denver 9, Colo.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Marion Electrical Instrument Co., Manchester, N. H. ADV. PG. 124.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Sanborn Co., 39 Osborn St., Cambridge 39, Mass. ADV. PG. 127.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

GASES—Inert

Linde Air Products Co., Unit of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

GASES—Liquefied

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Little, Inc., Arthur D., Cambridge 42, Mass. ADV. PG. 117.
Mathieson Chemical Corp., Mathieson Bldg., Baltimore 3, Md.
Will Corp., Rochester 3, N. Y.

GASES—Rare

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Linde Air Products Co., Unit of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

GASKETS

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Flexitallic Gasket Co., 8th & Bailey Sts., Camden 2, N. J. ADV. PG. 130.
General Electric Co., Chemical Div., Pittsfield, Mass. ADV. PGS. 75 to 86.
Hamilton Kent Mfg. Co., Kent, Ohio
Penn Fibre & Specialty Co., 2020 E. Westmoreland St., Philadelphia 34, Pa.
U. S. Gasket Co., 602 N. 10th St., Camden, N. J. ADV. PG. 122
U. S. Stoneware Corp., Akron 9, Ohio

G-M Apparatus

G-M APPARATUS

Anton Electronic Labs, Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Fisher Research Lab., Inc., 1961-63-65 University Ave., Palo Alto, Calif.
General Radio Co., 275 Massechusetts Ave., Cambridge 39, Mass.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Herbach & Rademan, Inc., 522 Market St., Philadelphia 6, Pa.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Precision Radiation Instruments, 413 W. Jefferson Blvd., Los Angeles 16, Calif.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Labaoratory, N., 5646 Harper Ave., Chicago 37, Ill.

G-M TUBE HOLDERS

Anton Electronic Labs, Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Detectron Co., 5631 Cahuenga Blvd. N. Hollywood, Calif.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Herbach & Rademan, Inc., 522 Market St., Philadelphia 6, Pa.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.

G-M Tubes

Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

G-M TUBES—Self-Quenching

Able Scientific Glass Apparatus Co., 6859 South Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs, Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electronic Products Co., 111 E. 3rd St., Mt. Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Herbach & Rademan, Inc., 522 Market St., Philadelphia 6, Pa.
Leighton Labs., H. W., 26 Herman St., Glen Ridge, N. J.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Raytheon Mfg. Co., Special Tube Section, 55 Chapel St., Newton 58, Mass. ADV. PG. 100.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

G-M TUBES—Thick Wall, Glass

Able Scientific Glass Apparatus Co., 6859 South Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs, Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.

G-M Tubes

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Distillation Products Industries, Rochester 3, N. Y.
Eck & Krebs, Inc., 27–09 40th Ave., Long Island City 1, N. Y.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electronic Products Co., 111 E. 3rd St., Mt. Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Herbach & Rademan, Inc., 522 Market St., Philadelphia 6, Pa.
Leighton Labs., H. W., 26 Herman St., Glen Ridge, N. J.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Raytheon Mfg. Co., Special Tube Section, 55 Chapel St., Newton 58, Mass. ADV. PG. 100.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

G-M TUBES—Thick Wall, Metal

Able Scientific Glass Apparatus Co., 6859 South Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs, Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Astell & Co., Inc., John B., 90 West Broadway, New York 7, N. Y.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electronic Products Co., 111 E. 3rd St., Mt. Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Leighton Labs., H. W., 26 Herman St., Glen Ridge, N. J.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.

G-M Tubes

Raytheon Mfg. Co., Special Tube Section, 55 Chapel St., Newton 58, Mass. ADV. PG. 100.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

G-M TUBES—Thin Wall

Able Scientific Glass Apparatus Co., 6859 South Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs, Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Astell & Co., Inc., John B., 90 West Broadway, New York, N. Y.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Eck & Krebs, Inc., 27–09 40th Ave., Long Island City 1, N. Y.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electronic Products Co., 111 E. 3rd St., Mt. Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Herbach & Rademan, Inc., 522 Market St., Philadelphia 6, Pa.
Leighton Labs., H. W., 26 Herman St., Glen Ridge, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Raytheon Mfg. Co., Special Tube Section, 55 Chapel St., Newton 58, Mass. ADV. PG. 100.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

G-M TUBES—Thin Window

Able Scientific Glass Apparatus Co., 6859 South Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England

Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electronic Products Co., 111 E. 3rd St., Mt. Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Herbach & Rademan, Inc., 522 Market St., Philadelphia 6, Pa.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nucleonic Corp. of America, 497 Union St., Brooklyn 3, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

GENERATORS—Audio Frequency

American Communications Corp., 306 Broadway, New York 7, N. Y.
Arlington Electric Products, Inc., 500 W. 52nd St., New York, N. Y.
Carnine & Bitter, 12 H St., N.E., Washington 2, D. C.
Clough Brengle Co., 6014 N. Broadway, Chicago, Ill.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Electronic Measurements Co., Red Bank, N. J.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Instrument Electronics Corp., 104 W. Jefferson St., Falls Church, Va.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Krohn-Hite Instrument Co., 580 Massachusettts Ave., Cambridge 39, Mass.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y.
Radio Corp. of America, RCA Victor Div., Tube Dept., 415 S. Fifth St., Harrison, N. J. ADV. PGS. 91, 106, 137.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Southwestern Industrial Electronic Co., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas
Teletronics Lab., Inc., 352 Maple Ave., Waterbury, N. Y.

Generators

GENERATORS—Motor

Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 1, Wis.
Carter Motor Co., 2644 N. Maplewood Ave., Chicago 47, Ill.
Eastern Air Devices, Inc., 585 Dean St., Brooklyn 17, N. Y.
Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Red Bank Division, Bendix Aviation Corp., Red Bank, N. J.
Small Motors, Inc., 2076 Elston Ave., Chicago 14, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

GENERATORS—Pulse

Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
American Communications Corp., 306 Broadway, New York 7, N. Y.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Berkeley Scientific Co., 6th & Nevin Ave., Richmond, Calif.
Berkshire Laboratories, 588 Lexington Rd., Concord, Mass.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Clough Brengle Co., 6014 N. Broadway, Chicago, Ill.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electronic Measurements Co., Red Bank, N. J.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Kay Electric Co., Maple Ave., Pine Brook, N. J.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Lavoie Labs., Morganville, N. J.
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y.
Measurements Corp., Boonton, N. J.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 W. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Potter Instrument Co., Inc., 115 Cutter Mill Rd., Great Neck, N. Y. ADV. PG. 139.
Teletronics Lab., Inc., 352 Maple Ave., Waterbury, N. Y.

GENERATORS—Signal

Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
Boonton Radio Corp., Boonton, N. J.
Carnine & Bitter, 12 H St., N.E., Washington 2, D. C.

Generators

Communication Devices Co., 2331 Twelfth Ave., New York 27, N. Y.
Communication Measurement Lab., Inc., 120 Greenwich St., New York 6, N. Y.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Daven Co., 191 Central Ave., Newark 4, N. J.
Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Electronic Measurements Co., Red Bank, N. J.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.
Marconi Instruments Ltd., 23–25 Beaver St., New York 4, N. Y.
Measurements Corp., Boonton, N. J.
New London Instrument Co., P. O. Box 189, New London, Conn.
Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.
Polytechnic Research & Development Co., 202 Tillary St., Brooklyn, N. Y.
Radio Corp. of America, RCA Victor Div., Tube Dept., 415 S. Fifth St., Harrison, N. J. ADV. PGS. 91, 106, 137.
Rollin Co., 2070 N. Fair Oaks Ave., Pasadena 3, Calif.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Southwestern Industrial Electronic Co., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas
Sperry Gyroscope Co., Div. of the Sperry Corp., Great Neck, N. Y.
Technology Instrument Corp., 531 Main St., Acton, Mass.

GENERATORS—Square Wave

Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
Carnine & Bitter, 12 H St., N.E., Washington 2, D. C.
Cinema-Television Ltd., Worsley Bridge Rd., London S. E. 26, England
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electronic Measurements Co., Red Bank, N. J.
Electro-Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.

Glassware

Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Laboratory for Electronics Inc., 11 Leon St., Boston 15, Mass.
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y.
Measurements Corp., Boonton, N. J.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y. ADV. PG. 139.
Tektronix, Inc., P. O. Box 831, Portland 7, Ore.
Universal X-Ray Products Inc., 1140 N. Western Ave., Chicago 22, Ill.

GLASS APPARATUS—Special

Able Scientific Glass Apparatus Co., 6859 South Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
Ace Glass, Inc., 1938 N. W. Blvd., Vineland, N. J.
Best Scientific Glass Apparatus Works, 2449 N. Clybourn Ave., Chicago 14, Ill.
Corning Glass Works, Corning, N. Y.
Distillation Products Industries, Rochester 3, N. Y.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Fish-Schurman Corp., 70 Portman Rd., New Rochelle, N. Y.
Glass Engineering Laboratories, Belmont, Calif.
Greiner Co., Otto R., 221 High St., Newark 2, N. J.
Huggins Laboratories, 734 Hamilton Ave., Menlo Park, Calif.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Kimble Glass Div., O. T. G. Co., Vineland, N. J.
Milwaukee Glass Works, Inc., 2338 N. 30th St., Milwaukee, Wis.
Paragon Glass Works, Inc., 963 Newark Ave., Elizabeth 3, N. J.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Wheaton Co., T. C., Millville, N. J.
Will Corp., Rochester 3, N. Y.

GLASS—Radiation Shielding

Penberthy Instrument Co., Hi-D Division, 666 Adams St., Seattle 8, Wash. ADV. PG. 138.

GLASSWARE—Laboratory

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Bellco Glass, Inc., 413 N. Fourth St., Vineland, N. J.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Corning Glass Works, Corning, N. Y.
Elmer & Amend, 635 Greenwich St., New York, N. Y.
Fish-Schurman Corp., 70 Portman Rd., New Rochelle, N. Y.
Hellige, Inc., 3718 Northern Blvd., Long Island City 1, N. Y.
Kimble Glass, Division of Owens-Illinois Glass Co., P. O. Box 1035, Toledo 1, Ohio
Kimble Glass Div., O. T. G. Co., Vineland, N. J.

Gloves

Kontes Glass Co., Spruce St., Vineland, N. J.
Leitz, Inc., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
Macalaster Bicknell Co., 243 Broadway, Cambridge 39, Mass.
Milwaukee Glass Works, Inc., 2338 N. 30th St., Milwaukee, Wis.
Nurnberg Thermometer Co., Inc., 124 Livingston St., Brooklyn 2, N. Y.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Rascher & Betzhold, Inc., 730 N. Franklin St., Chicago 10, Ill.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Specialty Glass Co., 536 Lake Shore Drive, Chicago 11, Ill.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Will Corp., Rochester 3, N. Y.

GLOVES—Rubber

Goodrich Co., B. F., 448 S. Main St., Akron, Ohio

GOGGLES—Acid and Dust Proof

Bache & Co., Semon, 636 Greenwich St., New York 14, N. Y.
Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.
Bullard Co., E. D., 275 Eighth St., San Francisco 3, Calif.
Davis Emergency Equipment Co., Inc., 252 Halleck St., Newark, N. J.
Willson Products, Inc., Reading, Pa.

HEATERS—Electric

Acme Electric Heating Co., Inc., 1205 Washington St., Boston, Mass.
Ambory Corp., 21320 Stephenson, Hazel Park, Mich.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, Ill.
Industrial Engineering & Equipment Co., 711 S. Theresa, St. Louis 3, Mo.
Laboratory Construction Co., 1113–1115 Holmes St., Kansas City, Mo.
Vulcan Electric Co., 88 Holten St., Danvers, Mass.
Watlow Electric Mfg. Co., 2256 Dickson St., St. Louis, Mo.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Will Corp., Rochester 3, N. Y.

HEATERS—Immersion

Acme Electric Heating Co., Inc., 1205 Washington St., Boston, Mass.
Ambory Corp., 21320 Stephenson Hazel Park, Mich.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

Hose

Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Industrial Engineering & Equipment Co., 711 S. Theresa, St. Louis 3, Mo.
Vulcan Electric Co., 88 Holten St., Danvers, Mass.
Watlow Electric Mfg. Co., 2256 Dickson St., St. Louis, Mo.
Western Blower Co., 1800 Airport Way, Seattle 66, Wash.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa..
Will Corp., Rochester 3, N. Y.

HEATERS—Induction, High Frequency

Allis-Chalmers Mfg., 1126 S. 70th St., Milwaukee 1, Wis.
Carnine & Bitter, 12 H St., N.E., Washington 2, D. C.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Marion Electrical Instrument Co., Manchester, N. H. ADV. PG. 124.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Sierra Electronic Corp., San Carlos, Calif.
Will Corp., Rochester 3, N. Y.

HOODS—Chemical

Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Bristol Metal Products Corp., Bristol, Tenn.
Bullard Co., E. D., 275 Eighth St., San Francisco 3, Calif.
Buttling-Padgett Co., Inc., 830 Whittier, New York, N. Y.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Haveg Corp., Newark 6, Delaware
Metal Products Corp., 48 W. 19th St., Weehawken, N. J.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.

HOSE—Acid Resisting

Blickman, Inc., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 4.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.
Goodrich Co., B. F., 448 S. Main St., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Irvington Varnish & Insulator Co., 6 Argyle Terrace, Irvington, N. J.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Republic Rubber Division of Lee Rubber & Tire Corp., Youngstown, Ohio
U. S. Stoneware Co., Akron 9, Ohio

HOSE—Metal, Flexible

American Brass Co., 25 Broadway, New York 4, N. Y.

Hose

American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Atlantic Metal Hose Co., 123 W. 64th St., New York 23, N. Y.

HOSE—Vacuum, Flexible

American Brass Co., 25 Broadway, New York 4, N. Y.
American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Goodyear Tire & Rubber Co., Akron, Ohio
Irvington Varnish & Insulator Co., 6 Argyle Terrace, Irvington, N. Y.
Republic Rubber Division of Lee Rubber & Tire Corp., Youngstown, Ohio
U. S. Stoneware Co., Akron 9, Ohio

HUMIDIFIERS

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Optical Film Engineering Co., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 140.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.
York Corp., York, Pa.

HYGROMETERS

Aeronautical Research Laboratories, General Mills, Inc., 2010 E. Hennepin Ave., Minneapolis 13, Minn. ADV. PG. 96.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Hastings Instrument Co., Box 1275, Hampton, Va.
Hill & Co., E. Vernon, 6829 W. Highland Ave., Chicago 31, Ill.
Illinois Testing Labs., Inc., 420 N. LaSalle St., Chicago 10, Ill.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Ave., Philadelphia 44, Pa.
Moeller Instrument Co., 132nd St. & 89th Ave., Richmond Hill 18, N. Y.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia 30, Pa.
Tagliabue Instruments Div., Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thermo Instruments Co., 1066 El Camino Real, Belmont, Calif.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Weksler Thermometer Corp., 52 W. Houston St., New York 12, N. Y.
Will Corp., Rochester 3, N. Y.

INDICATORS—Film Thickness

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Brooks Rotameter Co., Box A–1347, Lansdale, Pa.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Fielden Instrument Corp., 2920 N. 4th St., Philadelphia 33, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. Y.

Indicators

Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus 12, Ohio
Photobell Company, 116 Nassau St., New York 7, N. Y.

INDICATORS—Fluid Flow

Associated Valve & Engineering Co., 1150 Marquette Rd., Chicago 21, Ill.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Coral Designs Div., Henry G. Deitz Co., 12–16 Astoria Blvd., Long Island City 2, N. Y.
Ernst Water Column & Gage Co., 252 S. Livingston Ave., Livingston, N. J.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gaveco Labs., Inc., 2 East End Ave., New York 21, N. Y.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Infilco, Inc., P. O. Box 5033, Tucson, Ariz.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.

INDICATORS—Geiger Counter

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs, Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Cinema-Television Ltd., Worsley Bridge Rd., London S. E. 26, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Eck & Krebs, Inc., 27–09 40th Ave., Long Island City 1, N. Y.
Electronic Products Co., 111 E. 3rd St., Mt. Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Fisher Research Lab., Inc., 1961–63–65 University Ave., Palo Alto, Calif.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Georator Corp., 1820 N. Nash St., Arlington, Va.
International Instruments, Inc., P. O. Box 2954, New Haven 15, Conn.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Menlo Research Laboratory, Menlo Park, Calif.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.

Indicators

Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Special Instruments Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Will Corp., Rochester 3, N. Y.
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill.

INDICATORS—Humidity

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Cambridge Instrument Co., Inc., 3786 Grand Central Terminal, New York 17, N. Y.
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Electronic Products Co., 111 E. Third St., Mt. Vernon, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Hill & Co., E. Vernon, 6829 W. Highland Ave., Chicago 31, Ill.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Tagliabue Instruments Div. of Weston Eelctrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Thermo Instruments Co., 1066 El Camino Real, Belmont, Calif.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.
Will Corp., Rochester 3, N. Y.

INDICATORS—Liquid Level

Associated Valve & Engineering Co., 1150 W. Marquette Rd., Chicago 21, Ill.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Coral Designs Div., Henry G. Dietz Co., 12–16 Astoria Blvd., Long Island City 2, N. Y.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.

Indicators

Ernst Water Column & Gage Co., 252 S. Livingston Ave., Livingston, N. J.
Fielden Instrument Corp., 2920 N. 4th St., Philadelphia 33, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Fisher Research Lab., Inc., 1961–63–65 University Ave., Palo Alto, Calif.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Infilco, Inc., P. O. Box 5033, Tucson, Ariz.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Schaevitz Engineering, Crescent Blvd. at Drexel Ave., Camden 11, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thermo Instruments Co., 1066 El Camino Real, Belmont, Cal.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.

INDICATORS—Pressure

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Coral Designs Div., Henry G. Dietz Co., 12–16 Astoria Blvd., Long Island City 2, N. Y.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electro Products Labs., Inc., 4501 N. Ravenswood, Chicago 6, Ill.
Electronic Engineering Associates Ltd., 1040 Brittan Ave., San Carlos, Calif.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Keckley Co., O. C., 400 W. Madison St., Chicago 6, Ill.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Marsh Instrument Co., Skokie, Ill.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Photocon Research Products, 1062 N. Allen Ave., Pasadena 7, Calif.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Schaevitz Engineering, Crescent Blvd. at Drexel Ave., Camden 11, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.

INDICATORS—Temperature

Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Cambridge Instrument Co., Inc., 3786 Grand Central Terminal, New York 17, N. Y.
Edison, Inc., Thomas A., Instrument Div., West Orange, N. J.
Electric Auto Lite Co., Instrument & Gauge Div., Toledo, Ohio
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Fisher Research Lab., Inc., 1961–63–65 University Ave., Palo Alto, Calif.

Indicators

Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
Illinois Testing Labs., Inc., 420 N. LaSalle St., Chicago 10, Ill.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Keckley Co., O. C., 400 Madison St., Chicago 6, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Marsh Instrument Co., Skokie, Ill.
Micro-Circuits Co., New Buffalo, Mich.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Partlow Corp., The, 2 Campion Rd., New Hartford, N. Y.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Schaevitz Engineering, Crescent Blvd. at Drexel Ave., Camden 11, N. J.
Taco West Corp., 525 N. Noble St., Chicago 22, Ill.
Tagliabue Instruments Div. of Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark, N. J. ADV. PG. 135.
Wheelco Instruments Co., 847 W. Harrison St., Chicago 7, Ill.
Will Corp., Rochester 3, N. Y.

INDICATORS—Timing

American Chronoscope Corp., 316 W. First St., Mt. Vernon, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Cinema-Television Ltd., Worsley Bridge Rd., London S. E. 26., England
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Cramer Co., Inc., R. W., Centerbrook, Conn.
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gorrell & Gorrell, Haworth, N. J.
Haydon Mfg. Co., Inc., 584 E. Elm St., Torrington, Conn.
Photobell Company, 116 Nassau St., New York 7, N. Y.
Rhodes, Inc., M. H., 30 Bartholomew Ave., Hartford, Conn.
Standard Electric Time Co., 89 Logan St., Springfield, Mass.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

INDICATORS—Vacuum

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Distillation Products Industries, Rochester 3, N. Y.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.

Instruments

Electric Auto Lite Co., Instrument & Gauge Div., Toledo, Ohio
Electro Products Labs., Inc., 4501 N. Ravenswood, Chicago 6, Ill.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Hastings Instrument Co., Box 1275, Hampton, Va.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Marsh Instrument Co., Skokie, Ill.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
National Research Corp., 70 Memorial Drive, Cambridge 42, Mass. ADV. PGS. 94, 95.
Optical Film Engineering Co., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 140.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137.
Schaevitz Engineering, Crescent Blvd. at Drexel Ave., Camden 11, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Universal X-Ray Products Inc., 1140 N. Western Ave., Chicago 22, Ill.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

INSTRUMENT PARTS—Precision

Arma Corp., 254 36th St., Brooklyn 32, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Berndt-Bach Inc., 7377 Beverly Blvd., Los Angeles 36, Calif.
Cambridge Instrument Co., Inc., 3786 Grand Central Terminal, New York 17, N. Y.
Central Research Laboratories, Inc., Red Wing, Minn.
Chandler & Stedman, 398 Newton St., Waltham 54, Mass.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Gorrell & Gorrell, Haworth, N. J.
Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I.
Instrument Laboratories, 315 W. Walton Place, Chicago 10, Ill.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Maurer, Inc., J. A., 37–01 31st St., Long Island City, N. Y.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
United States Testing Co., Hoboken, N. J. ADV. PG. 103.
Vallorbs Jewel Co., Lancaster, Pa.

INSTRUMENTS—Graphic Recording

Alfax Paper & Engineering Co., P. O. Box 125, Westboro, Mass.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Berndt-Bach Inc., 7377 Beverly Blvd., Los Angeles 36, Calif.

Insulators

Edin Co., Inc., 207 Main St., Worcester, Mass.
Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gorrell & Gorrell, Haworth, N. J.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City, N. Y.
Rahm Instruments, Inc., 12 West Broadway, New York 7, N. Y.
Sanborn Co., 39 Osborn St., Cambridge 39, Mass. ADV. PG. 127.
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill. ADV. PG. 136.
Tagliabue Instruments Div., Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa

INSULATORS—Ceramic

American Lava Corp., Chattanooga 5, Tenn. ADV. PG. 97.
Centralab Div. of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.
Coors Porcelain Co., Golden, Colo.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Hermetic Seal Products Co., 29–37 S. 6th St., Newark 7, N. J.
Kirchberger & Co., Inc., M., 1425 37th St., Brooklyn 18, N. Y.
Locke Dept., General Electric Co., 1050 Cromwell St., Baltimore 3, Md.
Locke Insulator Corp., P. O. Box 57, Baltimore 3, Md.
Porcelain Products, Inc., 422 W. Sandusky St., Findlay, Ohio
Star Porcelain Co., 61 Muirhead Ave., Trenton 9, N. J.
Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.

INSULATORS—Fused Quartz

General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio. ADV. PGS. 75 to 86.
Hanovia Chemical & Mfg. Co., 233 N. J. R. R. Ave., Newark 5, N. J.

INSULATORS—Plastic

Haveg Corp., Newark 6, Delaware
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Irvington Varnish & Insulator Co., 6 Argyle Terrace, Irvington, N. J.
Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 119.
National Vulcanized Fibre Co., Wilmington 99, Del.
Penn Fibre & Specialty Co., 2020 E. Westmoreland St., Philadelphia 34, Pa.
U. S. Gasket Co., 602 N. 10th St., Camden, N. J. ADV. PG. 122.

Laboratories

Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

ISOTOPE-LABELED COMPOUNDS

Abbott Laboratories, North Chicago, Ill.
Distillation Products Industries, Rochester 3, N. Y.
Eldorado Mining & Refining Ltd., Ottawa, Ontario, Canada. ADV. PG. 114.
Metal Hyrides Inc., Beverly, Mass.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Texas Research Foundation, Renner, Texas
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
United States Testing Co., Hoboken, N. J. ADV. PG. 103.

ISOTOPES—Radioactive

Abbott Laboratories, North Chicago, Ill.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Eldorado Mining & Refining Ltd., Ottawa, Ontario, Canada. ADV. PG. 114.
Fleischman, Burd & Co., Inc., 22 W. 48th St., New York 19, N. Y.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
St. John X-Ray Laboratory, Califon, N. J.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Texas Research Foundation, Renner, Texas
Tracerlab Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
U. S. Radium Corp., 535 Pearl St., New York 7, N. Y.
United States Testing Co., Hoboken, N. J. ADV. PG. 103.

ISOTOPES—Stable

Distillation Products Industries, Rochester 3, N. Y.
Patterson, Moos & Co., 32–36 47th Ave., Long Island City 1, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Texas Research Foundation, Renner, Texas
Tracerlab Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

LABELS—Pressure Sensitive

Labelon Tape Co., 100 Anderson Ave., Rochester, N. Y.

LABORATORIES—Testing & Consulting

Armour Research Foundation, 35 W. 33rd St., Chicago, Ill.
Cook Research Labs., Div. Cook Electric Co., 1457 Diversey Parkway, Chicago 14, Ill.
Electrical Testing Laboratories, East End Ave. & 79th St., New York, N. Y.
Inland Testing Labs., Div. Cook Electric Co., 2700 Southport, Chicago 14, Ill.

Lamps

New York Testing Laboratories, Inc., 80 Washington St., New York 6, N. Y.
Nuclear Development Associates, Inc., 33 W. 60th St., New York, N. Y.
Tour & Co., Inc., Sam, 44 Trinity Place, New York, N. Y.
United States Testing Co., Inc., Hoboken, N. J. ADV. PG. 103.

LAMPS—Mercury Discharge

Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio. ADV. PGS. 75 to 86.
Huggins Laboratories, 734 Hamilton Ave., Menlo Park, Calif.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Menlo Research Laboratory, Menlo Park, Calif.
Will Corp., Rochester 3, N. Y.

LAMPS—Microscope

Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio. ADV. PGS. 75 to 86.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Will Corp., Rochester 3, N. Y.

LAMPS—Neon Glow

Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio. ADV. PGS. 75 to 86.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.

LAMPS—Sodium Arc

Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio. ADV. PGS. 75 to 86.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Will Corp., Rochester 3, N. Y.

LAMPS—Ultraviolet

Fisher Research Laboratory, Inc., 1961–63–65 University Ave., Palo Alto, Calif.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio. ADV. PGS. 75 to 86.
Huggins Laboratories, 734 Hamilton Ave., Menlo Park, Calif.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Menlo Research Laboratory, Menlo Park, Calif.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Radiosotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Will Corp., Rochester 3, N. Y.

LEAD GLASS

Bache & Co., Semon, 636 Greenwich St., New York 14, N. Y.

Machines

Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Corning Glass Works, Corning, N. Y.
Penberthy Instrument Co., Hi-D Division, 666 Adams St., Seattle 8, Wash. ADV. PG. 138.

LEAK TESTERS

Davis Emergency Equipment Co., 252 Halleck St., Newark, N. J.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Highside Chemicals Co., 10 Colfax Ave., Clifton, N. J.
Menlo Research Laboratory, Menlo Park, Calif.
National Research Corp., 70 Memorial Drive, Cambridge 42, Mass. ADV. PGS. 94, 95.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137.
Vacuum-Electronic Engineering Co., 756 Third Ave., Brooklyn 32, N. Y. ADV. PG. 128.

LIGHTS—Monochromatic

Distillation Products Industries, Rochester 3, N. Y.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St. New York 70, N. Y.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio. ADV. PGS. 75 to 86.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Leitz, Inc., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
Menlo Research Laboratory, Menlo Park, Calif.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Will Corp., Rochester 3, N. Y.

MACHINES—Electronic & Mechanical Computing

Air Associates Inc., Teterboro, N. J. ADV. PG. 133.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Carnine & Bitter, 12 H St., N.E., Washington 2, D. C.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Communication Measurement Lab., Inc., 120 Greenwich St., New York 6, N. Y.
General Electric Co, Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Melpar Inc., 452 Swann Ave., Alexandria, Va.
Miller Corp., William, 325 N. Halstead Ave., Pasadena 8, Calif.
Minnesota Electronics Corp., 97 E. 5th St., St. Paul 1, Minn.
Patterson, Moos & Co., Inc., 32–36 4th Ave., Long Island City 1, N. Y.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y. ADV. PG. 139.
Servomechanisms, Inc., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 126.

MACHINES—Glass Working

Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Kahle Engineering Co., 1307 Seventh St., North Bergen, N. J.
Litton Industries, San Carlos, Calif.
Standard Tool & Mfg. Co., Arlington, N. J.

Magnets

MAGNETS

Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
Arnold Engineering Co., Marengo, Ill.
Carboloy Dept., General Electric Co., 11155 E. Eight Mile Rd., Detroit 32, Mich.
Crucible Steel Corp. of America, 405 Lexington Ave., New York 17, N. Y.
Georator Corp., 1820 N. Nash St., Arlington, Va.
High Voltage Engineering Corp., 7 University Rd., Cambridge 38, Mass. ADV. PG. 101.
Indiana Steel Products Co., 700 Valparaiso St., Valparaiso, Ind.
Little, Inc., Arthur D., Cambridge 42, Mass. ADV. PG. 117.
Permoflux Corp., 4900 W. Grand Ave., Chicago 39, Ill.
Varian Associates, 990 Varian St., San Carlos, Calif.

MANIPULATORS

Aeronautical Research Labs., General Mills, Inc., 2010 E. Hennepin Ave., Minneapolis 13, Minn. ADV. PG. 96.
Air Associates Inc., Teterboro, N. J. ADV. PG. 133.
Central Research Laboratories, Inc., Red Wing, Minn.
Eldorado Mining & Refining, Ltd., Ottawa, Ontario, Canada. ADV. PG. 114.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.

MANOMETERS

Able Scientific Glass Co., 6859 S. Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
Bethlehem Apparatus Co., Inc., Front & Depot Sts., Hellertown, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, 345 Harris Ave., Providence 1, R. I.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Hastings Instrument Co., Box 1275, Hampton, Va.
Hill & Co., E. Vernon, 6829 W. Highland Ave., Chicago 31, Ill.
Infilco, Inc., P. O. Box 5033, Tucson, Ariz.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Phoenix Precision Instrument Co., 3803–05 North St., Philadelphia, Pa.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia 30, Pa.
Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia 42, Pa.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Technitrol Engineering Corp., 3211 Woodland Ave., Philadelphia 4, Pa.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Will Corp., Rochester 3, N. Y.

MANOMETERS—U-Type

Able Scientific Glass Co., 6859 S. Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
Distillation Products Industries, Rochester 3, N. Y.
Garrell & Garrell, Haworth, N. J.
Infilco, Inc., P. O. Box 5033, Tucson, Ariz.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.

Metalloscopes

Sanborn Co., 39 Osborn St., Cambridge, Mass. ADV. PG. 127.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Will Corp., Rochester 3, N. Y.

MANTLES—Heating

Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.

MASKS—Dust, Fume, Gas, Smoke, etc.

Bullard Co., E. D., 275 Eighth St., San Francisco 3, Calif.
Davis Emergency Equipment Co., Inc., 252 Halleck St., Newark, N. J.
De Vilbiss Co., 300 Phillips Ave., Toledo, Ohio
Martindale Electric Co., Hird Ave., Cleveland 7, Ohio
Willson Products, Inc., Reading, Pa.
York Corp., York, Pa.

MEGOHMMETERS

Associated Research, Inc., 3758 W. Belmont, Chicago, Ill.
Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Communication Measurement Lab., Inc., 120 Greenwich St., New York 6, N. Y.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Industrial Instruments, Inc., 17 Pollack Ave., Jersey City 5, N. J.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Keithley Instruments, 3868 Carnegie Ave., Cleveland, Ohio
Martindale Electric Co., Hird Ave., Cleveland 7, Ohio
Precision Apparatus Co., Inc., 92–27 Horace Harding Blvd., Elmhurst, N. Y.
Shallcross Mfg. Co., 10 Jackson Ave., Collingdale, Pa.
Southwestern Industrial Electronic Co., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas
Special Instrument Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Tech Laboratories, Inc., Bergen and Edsall Blvds., Palisades Park, N. J.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.

METALLOSCOPES

Fisher Research Lab., Inc., 1961–63–65 University Ave., Palo Alto, Calif.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Will Corp., Rochester 3, N. Y.

METALS

Alnico

Arnold Engineering Co., Marengo, Ill.
Carboloy Dept., General Electric Co., 11155 E. Eight Mile Rd., Detroit 32, Mich.
Indiana Steel Products Co., 700 Valparaiso St., Valparaiso, Ind.

Aluminum

Aluminum Co. of America, 2156 Gulf Bldg., Pittsburgh, Pa.
American Brass Co., 25 Broadway, New York 4, N. Y.
Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Imperial Cantrell Mfg. Co., Jellico, Tenn.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Kaiser Aluminum & Chemical Sales, Inc., 1924 Broadway, Oakland 12, Calif.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.

Antimony

Alpha Metals, Inc., 363 Hudson Ave., Brooklyn 1, N. Y.
Andel & Co., Inc., 5218 N. Kedzie Ave., Chicago, Ill.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
National Lead Co., 111 Broadway, New York 6, N. Y.

Arsenic

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Cerro de Pasco Corp., 40 Wall St., New York 5, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

Barium

Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
King Laboratories, Inc., 127 Solar St., Syracuse 4, N. Y.

Beryllium and Beryllium Alloys

American Silver Co., Inc., 36–07 Prince St., Flushing, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Brush Beryllium Co., The, 4301 Perkins Ave., Cleveland 3, Ohio
Gas & Oil Industry Laboratories, Inc., 2 Paine Ave., Irvington 11, N. J.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Sherman & Co., 36–07 Prince St., Flushing, N. Y.

Bismuth

American Smelting & Refining Works, 120 Broadway, New York, N. Y.
Anaconda Copper Mining Co., 25 Broadway, New York, N. Y.
Cerro de Pasco Corp., 40 Wall St., New York 5, N. Y.

Brass and Bronze

American Brass Co., 25 Broadway, New York 4, N. Y.
American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
American Silver Co., Inc. 36–07 Prince St., Flushing, N. Y.

Metals

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Bridgeport Brass Co., 30 Grand St., Bridgeport 2, Conn.
Chase Brass & Copper Co., Waterbury 20, Conn.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Imperial Cantrell Mfg. Co., Jellico, Tenn.
Phelps Dodge Refining Corp., 40 Wall St., New York 5, N. Y.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Sherman & Co., 36–07 Prince St., Flushing, N. Y.

Cadmium

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Eagle-Picher Co., Cincinnati, Ohio
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

Cerium

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

Chromium

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Carpenter Steel Co., Reading, Pa.
Electro Metallurgical Division, Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Metal Hyrides Inc., Beverly, Mass.

Coefficient Metals

Alloy Tube Division of Carpenter Steel Co., Union, N. J.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Carpenter Steel Co., Reading, Pa.
Driver-Harris Co., Harrison, N. J.
Gas & Oil Industry Laboratories, Inc., 2 Paine Ave., Irvington 11, N. J.

Columbium

Carpenter Steel Corp., Reading, Pa.
Electro Metallurgical Div., Union Carbide Corp., 30 E. 42nd St., New York 17, N. Y.
Metal Hyrides Inc., Beverly, Mass.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

Copper

American Brass Co., 25 Broadway, New York 4, N. Y.
Anaconda Wire & Cable Corp., 25 Broadway, New York 4, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Bridgeport Brass Co., 30 Grand St., Bridgeport 2, Conn.
Chase Brass & Copper Co., Waterbury 20, Conn.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Phelps Dodge Refining Corp., 40 Wall St., New York 5, N. Y.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
U. S. Metals Refining Co., 61 Broadway, New York, N. Y.

Foil-Aluminum, Tin & Lead

Alpha Metals, Inc., 363 Hudson Ave., Brooklyn 1, N. Y.

Metals

Aluminum Co. of America, 2156 Gulf Bldg., Pittsburgh, Pa.
Andel & Co., Inc., 5218 N. Kedzie Ave., Chicago, Ill.
Bar-Ray Products, Inc., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 104, 105.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Kaiser Aluminum & Chemical Sales, Inc., 1924 Broadway, Oakland 12, Calif.
Will Corp., Rochester 3, N. Y.

Gallium

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Eagle-Picher Co., Cincinnati, Ohio
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.

Germanium

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Eagle-Picher Co., Cincinnati, Ohio
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

Gold and Gold Alloys

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark 5, N. J.
American Silver Co., Inc., 36–07 Prince St., Flushing, N. Y.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Handy & Harman, 82 Fulton St., New York 38, N. Y.
Hoover & Strong, Inc., 129 W. Tupper Bldg., Buffalo, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Ney Co., J. M., 71 Elm St., Hartford 1, Conn.
Sherman & Co., 36–07 Prince St., Flushing, N. Y.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
White Dental Mfg. Co., S. S., 10 E. 40th St., New York, N. Y.

High Permeability Alloys

Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
Alloy Metal Wire Co., 13th & Pennsylvania Ave., Prospect Park, Pa.
Alloy Tube Division of Carpenter Steel Co., Union, N. J.
Arnold Engineering Co., Marengo, Ill.
Carpenter Steel Co., Reading, Pa.
Driver-Harris Co., Harrison, N. J.
Indiana Steel Products Co., 700 Valparaiso St., Valparaiso, Ind.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Steward Mfg. Co., D. M., E. 36th St., Chattanooga 1, Tenn.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

Indium

Cerro de Pasco Corp., 40 Wall St., New York 5, N. Y.
Indium Corp. of America, 60 E. 42nd St., New York 17, N. Y.

Metals

Iridium

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark, N. J.

Laminated Metal Parts

American Silver Co., Inc., 36–07 Prince St., Flushing, N. Y.
Keller Products, Inc., Manchester, N. H.
Sherman & Co., 36–07 Prince St., Flushing, N. Y.

Lead and Lead Alloys

Alpha Metals Inc., 363 Hudson Ave., Brooklyn, N. Y.
Andel & Co., Inc., 5218 N. Kedzie Ave., Chicago, Ill.
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
du Pont de Nemours & Co., E. I., Wilmington 98, Del.
Eagle-Picher Co., Cincinnati, Ohio
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Glidden Co., 11001 Madison Ave., Cleveland 2, Ohio
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Miller, Inc., Ray, 340 Dayton St., Newark, N. J.
National Lead Co., 111 Broadway, New York 6, N. Y.

Magnesium

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Dow Chemical Co., Midland, Mich.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Kaiser Aluminum & Chemical Sales, Inc., 1924 Broadway, Oakland 12, Calif.

Manganese

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Electro Metallurgical Division, Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.

Mercury

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Eberbach Corporation, Ann Arbor, Mich.
Hoover & Strong, Inc., 129 W. Tupper Bldg., Buffalo N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Minimax Co., 5905 N. Clark St., Chicago 26, Ill.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.

Molybdenum

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Cross Co., H., 15 Beekman St., New York 7, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Westinghouse Electric Corp., Electronic Tube Sales Dept., Bloomfield, N. J.

Nickel and Nickel Alloys

Alloy Metal Wire Co., 13th & Pennsylvania Ave., Prospect Park, Pa.,
Alloy Tube Division of Carpenter Steel Co., Union, N. J.
American Oxygen Service Corp., 600 Essex St., Harrison, N. J.

Metals

American Silver Co., Inc., 36–07 Prince St., Flushing, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Carpenter Steel Co., Reading, Pa.
Driver-Harris Co., Harrison, N. J.
Gas & Oil Industry Laboratories, Inc., 2 Paine Ave., Irvington 11, N. J.
Haynes Stellite Division, Union Carbide & Carbon Corp., Kokomo, Indiana
International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Metal Hyrides, Inc., Beverly, Mass.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Sherman & Co., 36–07 Prince St., Flushing, N. Y.
Thomsen & Sons, L. C., Kenosha, Wis.
Wall Colmonoy Corp., 19345 John R. St., Detroit 3, Mich.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

Nickel Ribbon

Alloy Metal Wire Co., 13th & Pennsylvania Ave., Prospect Park, Pa.
Driver-Harris Co., Harrison, N. J.

Osmium

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark 5, N. J.

Palladium

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark 5, N. J.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Bishop & Co., J., Malvern, Pa.
Hoover & Strong, Inc., 129 W. Tupper Bldg., Buffalo N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Makepeace Co., D. E., Attleboro, Mass.
Ney Co., J. M., 7 Elm St., Hartford, Conn.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.

Phosphor Bronze

Amercian Brass Co., 25 Broadway, New York 4, N. Y.
American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Anaconda Wire & Cable Corp., 25 Broadway, New York 4, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Bridgeport Brass Co., 30 Grand St., Bridgeport 2, Conn.
Keystone Carbon Co., Inc., Saint Marys, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Sherman & Co., 36–07 Prince St., Flushing, N. Y.

Platinum

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark 5, N. J.
Anaconda Wire & Cable Corp., 25 Broadway, New York 4, N. Y.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Bishop & Co., J., Malvern, Pa.
Hoover & Strong, Inc., 129 W. Tupper Bldg., Buffalo, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
U. S. Metals Refining Co., 61 Broadway, New York, N. Y.

Metals

Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.

Polonium

Canadian Radium & Uranium Corp., 630 Fifth Ave., New York 20, N. Y.
Eldorado Mining & Refining Ltd., Ottawa, Ontario, Canada. ADV. PG. 114.
U. S. Radium Corp., 535 Pearl St., New York 7, N. Y.

Powdered

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Handy & Harman, 82 Fulton St., New York 38, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Keystone Carbon Co., Inc., Saint Marys, Pa.,
King Laboratories, Inc., 127 Solar St., Syracuse 4, N. Y.
Metal Hyrides Inc., Beverly, Mass.
U. S. Metals Refining Co., 61 Broadway, New York, N. Y.
Wall Colmonoy Corp., 19345 John R St., Detroit 3, Mich.

Radium

Canadian Radium & Uranium Corp., 630 Fifth Ave., New York 20, N. Y.
Eldorado Mining & Refining Ltd., Ottawa, Ontario, Canada. ADV. PG. 114.
U. S. Radium Corp., 535 Pearl St., New York 7, N. Y.

Rhodium

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark 5, N. J.

Ruthenium

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark 5, N. J.

Silicon

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Electro Metallurgical Division, Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.

Silver

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark 5, N. J.
American Silver Co., Inc., 36–07 Prince St., Flushing, N. Y.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Handy & Harman, 82 Fulton St., New York 38, N. Y.
Hoover & Strong, Inc., 129 W. Tupper Bldg., Buffalo, N. Y.
Jarrell-Ash Co. 165 Neuberry St., Boston 16, Mass.
Makepeace Co., D. E., Attleboro, Mass.
Ney Co., J. M., 71 Elm St., Hartford 1, Conn.
Sherman & Co., 36–07 Prince St., Flushing, N. Y.
U. S. Metals Refining Co., 61 Broadway, New York, N. Y.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.

Silver Alloys and Compounds

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
American Platinum Works, N. J. R. R. Ave. at Oliver

Metals

St., Newark 5, N. J.
American Silver Co., Inc., 36–07 Prince St., Flushing, N. Y.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Handy & Harman, 82 Fulton St., New York 38, N. Y.
Hoover & Strong, Inc., 129 W. Tupper Bldg., Buffalo, N. Y.
Jarrell-Ash Co. 165 Neuberry St., Boston 16, Mass.
Makepeace Co., D. E., Attleboro, Mass.
Mallory & Co., Inc., P. R. 3029 E. Washington St., Indianapolis 6, Ind.
Minimax Co., 5905 N. Clark St., Chicago 26, Ill.
Ney Co., J. M., 71 Elm St., Hartford 1, Conn.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Sherman & Co., 36–07 Prince St., Flushing, N. Y.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.

Steel

Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., Reading, Pa.
Crucible Steel Co. of America, 405 Lexington Ave., New York 17, N. Y.
Jarrell-Ash Co. 165 Neuberry St., Boston 16, Mass.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.

Steel, Stainless

Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
Alloy Metal Wire Co., 13th & Pennsylvania Ave., Prospect Park, Pa.
Alloy Tube Division of Carpenter Steel Co., Union, N. J.
American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Carpenter Steel Co., Reading, Pa.
Crucible Steel Co. of America, 405 Lexington Ave., New York 17, N. Y.
Driver-Harris Co., Harrison, N. J.
Keystone Carbon Co., Inc., Saint Marys, Pa.
Sherman & Co., 36–07 Prince St., Flushing, N. Y.

Strontium

Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
King Laboratories, Inc., 127 Solar St., Syracuse 4, N. Y.

Tantalum

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Bishop & Co., J., Malvern, Pa.
Cross Co., H., 15 Beekman St., New York 7, N. Y.
Electro Metallurgical Division, Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Metal Hyrides Inc., Beverly, Mass.

Thermostatic Bi-Metals

See Bi-Metals, Thermostatic

Tin

Alpha Metals, Inc., 363 Hudson Ave., Brooklyn 1, N. Y.
Andel & Co., Inc., 5218 N. Kedzie Ave., Chicago, Ill.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.

Meters

Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
National Lead Co., 111 Broadway, New York 6, N. Y.

Titanium

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Crucible Steel Co. of America, 405 Lexington Ave., Ave., New York 17, N. Y.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Electro Metallurgical Division, Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Glidden Co., 11001 Madison Ave., Cleveland 2, Ohio
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Metal Hyrides Inc., Beverly, Mass.
National Lead Co., 111 Broadway, New York 6, N. Y.

Tungsten

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Cross Co., H., 15 Beekman St., New York 7, N. Y.
Electro Metallurgical Division, Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Westinghouse Electric Corp., Electronic Tube Sales Dept., Bloomfield, N. J.

Tungsten Ribbon

Cross Co., H., 15 Beekman St., New York 7, N. Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

Uranium

Eldorado Mining & Refining Ltd., Ottawa, Ontario, Canada. ADV. PG. 114.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Mallinckrodt Chemical Works, Second & Mallinckrodt Sts., St. Louis 7, Mo.

Zinc

Andel & Co., Inc., 5218 N. Kedzie Ave., Chicago, Ill.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Cross Co., H., 15 Beekman St., New York 7, N. Y.
Eagle-Picher Co., Cincinnati, Ohio
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Jasonols Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
National Lead Co., 111 Broadway, New York 6, N. Y.

Zirconium

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Electro Metallurgical Division, Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Foote Mineral Co., 18 W. Chelten Ave., Philadelphia 44, Pa.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Metal Hyrides Inc., Beverly, Mass.
National Lead Co., 111 Broadway, New York 6, N. Y.

METERS—Counting Rate

Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.

Meters

Berkeley Scientific Co., 6th & Nevin, Richmond, Calif. ADV. PG. 113.
Carnine & Bitter, 12 H St., N.E., Washington 11, D. C.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
General Radio Co., 275 Massachusetts Ave., Cambridge 30, Mass.
Georator Corp, 1820 N. Nash St., Arlington, Va.
Gorrell & Gorrell, Haworth, N. J.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass. ADV. PG. 138.
Mininesota Electronics Corp., 97 E. 5th St., St. Paul 1, Minn.
National Radiac, Inc., 10 Crawford St., Newark 2, N. J. ADV. PG. 136.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Instrument & Chemical Co., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Precision Radiation Instruments, 413 W. Jefferson Blvd., Los Angeles 16, Calif.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137.
Radioactive Products, Inc., 443 Congress St., Detroit 26, Mich.
Special Instruments Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

METERS—Electric

Assembly Products, Inc., Chagrin Falls, Ohio
Associated Research, Inc., 3758 W. Belmont, Chicago, Ill.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.

Meters

Rhodes Inc., M. H., 30 Bartholomew Ave., Hartford, Conn.
Sangamo Electric Co., Springfield, Ill.
Welch Scientific Co., W. M., 1616 Sedgwick St., Chicago 10, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.

METERS—Flow

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio
Brooks Rotameter Co., Box A-1347, Lansdale, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, 345 Harris Ave., Providence 1, R. I.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Hagen Corp., 323 Fourth Ave., Pittsburgh 30, Pa.
Hastings Instrument Co., Box 1275, Hampton, Va.
Infilco, Inc., P. O. Box 5033, Tuscon, Ariz.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Technitrol Engineering Corp., 3211 Woodland Ave., Philadelphia 4, Pa.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Worthington Pump & Machinery Corp., 426 Worthington Ave., Harrison, N. J.

METERS—Gas, Precision Metering

Brooks Rotameter Co., Box A-1347, Lansdale, Pa.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Will Corp., Rochester 3, N. Y.

METERS—Gauss

General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.

METERS, MULTIMETERS, VOLT-OHM-MILLIAMMETERS

American Communications Corp., 306 Broadway, New York 7, N. Y.
Associated Research, Inc., 3758 W. Belmont, Chicago, Ill.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Instrument Laboratories, 315 W. Walton Place, Chicago, Ill.
International Instruments, Inc., P. O. Box 2954, New Haven 15, Conn.
Marion Electrical Instrument Co., Manchester, N. H. ADV. PG. 124.
Meters, Inc., 5353 N. Keystone Ave., Indianapolis 20, Ind.
Precision Apparatus Co., Inc., 92–27 Horace Harding Blvd., Elmhurst, N. Y.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.

Meters

Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.

METERS—pH

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Cambridge Instrument Co., Inc., 3786 Grand Central Terminal, New York 17, N. Y.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Coleman Instruments, Inc., Maywood, Ill.,
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Macbeth Corp., Cocheton Turnpike, P. O. Box 950, Newburgh, N. Y.
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Network Mfg., Corp., 213 W. 5th St., Bayonne, N. J.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Welch Scientific Co., W. M., 1616 Sedgwick St., Chicago 10, Ill.
Will Corp., Rochester 3, N. Y.

METERS—Recording

Audio Instrument Co., Inc., 133 W. 14th St., New York 11, N. Y.
Brooks Rotameter Co., Box A-1347, Lansdale, Pa.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gorrell & Gorrell, Haworth, N. J.
Infilco, Inc., P. O. Box 5033, Tuscon, Ariz.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Worthington Pump & Machinery Corp., 426 Worthington Ave., Harrison, N. J.

METERS—Roughness

General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.

METERS—Survey, Radiation

Alco Mfg. Co., 4011 Cuming St., Omaha 3, Neb.

Meters

Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electronic Products Co., 111 E. Third St., Mt. Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
Georator Corp, 1820 N. Nash St., Arlington, Va.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
International Instruments, Inc., P. O. Box 2954, New Haven 15, Conn.
Kelley-Koett Instrument Co., 930 York Ave., Cincinnati 14, Ohio
Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 119.
Menlo Research Laboratory, Menlo Park, Calif.
New London Instrument Co., P. O. Box 189, New London, Conn.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Ohmart Corp., 2347 Ferguson Ave., Cincinnati 5, Ohio. ADV. PG. 123.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Precision Radiation Instruments, 413 W. Jefferson Blvd., Los Angeles 16, Calif.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Special Instrument Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Will Corp., Rochester 3, N. Y.

METERS—Thermocouple

Assembly Products, Inc., Chagrin Falls, Ohio
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
General Controls Co., Glendale 1, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Illinois Testing Labs., Inc., 420 N. LaSalle St., Chicago 10, Ill.

Meters

Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
International Instruments, Inc., P. O. Box 2954, New Haven 15, Conn.
Marion Electrical Instrument Co., Manchester, N. H. ADV. PG. 124.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Sensitive Research Instrument Corp., 9 Elm Ave., Mt. Vernon, N. Y.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Taco West Corp., 525 N. Noble St., Chicago 22, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.

METERS—Water Turbidity

American Instrument Co. Inc., 8030 Georgia Ave., Silver Spring, Md.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.

METERS—X-Ray Intensity

Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., X-Ray Dept., 4855 Electric Ave., Milwaukee, Wis. ADV. PGS. 75 to 86.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Picker X-Ray Corp., 300 Fourth Ave., New York 10, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.

MICA

Continental Diamond Fibre Co., Newark, Delaware
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

Microscopes

MICROAMMETERS

See Electrical Testing & Indicating Equipment

MICROCHEMICAL EQUIPMENT

Chandler & Stedman, 398 Newton St., Waltham 54, Mass.
Corning Glass Works, Corning, N. Y.
Eimer & Amend, 25 Greenwich St., New York, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.

MICRO-MICROAMMETERS, ELECTRONIC

See Electrical Testing & Indicating Equipment

MICROSCOPES—Binocular

Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.
Buhl Optical Co., 1009 Beech Ave., Pittsburgh 12, Pa.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Leitz, Inc., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
Will Corp., Rochester 3, N. Y.

MICROSCOPES—Electron

Farrand Optical Co., Inc., Bronx Blvd. & E. 238th St., New York 70, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Leitz, Inc., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137.

MICROSCOPES—Laboratory

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.
Buhl Optical Co., 1009 Beech Ave., Pittsburgh 12, Pa.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Leitz, Inc., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Will Corp., Rochester 3, N. Y.

MICROSCOPES—Pertographic

Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Leitz, Inc., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
Will Corp., Rochester 3, N. Y.

MICROSCOPES—Stereoscopic

Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Leitz, Inc., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
Will Corp., Rochester 3, N. Y.

Microspectroscopes

MICROSPECTROSCOPES

Cambridge Instrument Co., Inc., 3786 Grand Central Terminal, New York 17, N. Y.
International Equipment Co., 1284 Soldiers Field Rd., Boston 35, Mass.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Leitz, Inc., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
Will Corp., Rochester 3, N. Y.

MICROTOMES

American Optical Co., Instrument Div., Buffalo 15, N. Y.
International Equipment Co., 1284 Soldiers Field Rd., Boston 35, Mass.

MILLIAMMETERS

See Electric Testing & Indicating Equipment

MILLS—Laboratory

Beach-Russ Co., 44 Church St., New York 7, N. Y.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Laboratory Construction Co., 1113–1115 Holmes St., Kansas City, Mo.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Will Corp., Rochester 3, N. Y.

MINOMETERS

Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 119.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.

MIXERS—Laboratory

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Beach-Russ Co., 44 Church St., New York 7, N. Y.
Brookfield Engineering Labs., Inc., Porter St., Stoughton, Mass.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
General Mixing Equipment Co., 411 N. 3rd St., Philadelphia, Pa.
International Engineering, Inc., 1200 Bolander Ave., Dayton, Ohio
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Mixing Equipment Co., 192 Mt. Read Blvd., Rochester 11, N. Y.
Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Phipps & Bird, Inc., 303 S. Sixth St., Richmond 5, Va.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
United Blower Co., Inc., 193 Center St., New York, N. Y.
Will Corp., Rochester 3, N. Y.

MONITORS—Area

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.

Monitors

Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Berkeley Scientific Co., 6th & Nevin, Richmond, Calif. ADV. PG. 113.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Georator Corp, 1820 N. Nash St., Arlington, Va.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 119.
Nuclear Instrument & Chemical Co., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Will Corp., Rochester 3, N. Y.

MONITORS—Line

Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.

MONITORS—Personnel

Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Berkeley Scientific Co., 6th & Nevin, Richmond, Calif. ADV. PG. 113.
Cambridge Instrument Co., Inc., 3786 Grand Central Terminal, New York 17, N. Y.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif. ADV. PGS. 98, 99.
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 119.
Menlo Research Laboratory, Menlo Park, Calif.
Minimax Co., 5905 N. Clark St., Chicago 26, Ill.
Nuclear Instrument & Chemical Co., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.

Monitors

R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Samples Machine Co., A. M., 506 N. Central Ave., Knoxville, Tenn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 7, Calif.
Will Corp., Rochester 3, N. Y.

MONITORS—Sample

Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Douglas Radio Labs, 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Landsverk Electrometer Co., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 119.
New London Instrument Co., P. O. Box 189, New London, Conn.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

MORTAR GRINDER

Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Will Corp., Rochester 3, N. Y.

MORTARS—Mullite

Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.

MORTARS & PESTLES

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Braecher Co., 12 River Rd., Chatham, N. J.
Will Corp., Rochester 3, N. Y.

MOTOR—GENERATOR

Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 1, Wis.
Eastern Air Devices, Inc., 585 Dean St., Brooklyn 17, N. Y.
Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.

Optical Instruments

Georator Corp, 1820 N. Nash St., Arlington, Va.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Red Bank Division, Bendix Aviation Corp., Red Bank, N. J.
Small Motors, Inc., 2076 Elston Ave., Chicago 14, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

MOTORS—Fractional hp

Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
Carron Mfg. Co., Sub. of United Pressed Products Co., 741 W. Harrison St., Chicago 7, Ill.
Eastern Air Devices, Inc., 585 Dean St., Brooklyn 17, N. Y.
Fasco Industries, Inc., Rochester 2, N. Y.
Ford Instrument Co., 31–10 Thomson Ave., Long Island City, N. Y.
Gale Dorothea Mechanisms, 81–01 Broadway, Elmhurst, N. Y.
General Electric Co., Apparatus Marketing Div., Schenecatdy 5, N. Y. ADV. PGS. 75 to 86.
Kollsman Instrument Co., 80–08 45th Ave., Elmhurst, N. Y.
Red Bank Division, Bendix Aviation Corp., Red Bank, N. J.
Small Motors Inc., 2076 Elston Ave., Chicago 14, Ill.
Specialty Battery Co., Madison 4, Wis.

NEUTRON SOURCES

Canadian Radium & Uranium Corp., 630 Fifth Ave., New York 20, N. Y.
Eldorado Mining & Refining, Ltd., Ottawa, Ontario, Canada. ADV. PG. 114.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
U. S. Radium Corp., 535 Pearl St., New York 7, N. Y.

OBJECTIVES—Achromatic

Buhl Optical Co., 1009 Beech Ave., Pittsburgh 12, Pa.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Leitz, Inc., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
Optical Film Engineering Co., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 140.
Perkin-Elmer Corp., Norwalk, Conn.
Will Corp., Rochester 3, N. Y.

OPTICAL INSTRUMENTS

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.
Berndt-Bach Inc., 7377 Beverly Blvd., Los Angeles 36, Calif.
Buhl Optical Co., 1009 Beech Ave., Pittsburgh 12, Pa.
Farrand Optical Co., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Leitz, Inc., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
Menlo Research Laboratory, Menlo Park, Calif.
Optical Film Engineering Co., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 140.
Penberthy Instrument Co., Hi-D Division, 666 Adams St., Seattle 8, Wash. ADV. PG. 138.
Perkin-Elmer Corp., Norwalk, Conn.

Oscillographs

Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Rudolph & Sons, O. C., P. O. Box 446, Caldwell, N. J.
United States Testing Co., Hoboken, N. J. ADV. PG. 103.
Will Corp., Rochester 3, N. Y.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia 7, Pa.
Zeiss, Inc., Carl, 485 Fifth Ave., New York 17, N. Y.
Zenith Optical Co., Huntington, W. Va.

OSCILLOGRAPHS

Central Research Laboratories, Inc., Red Wing, Minn.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Edin Co., Inc., 207 Main St., Worcester, Mass.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electrodyne Co., 320 Oliver St., Boston, Mass.
Electro-Medical Lab., Inc., South Woodstock 6, Vt.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Hathaway Instrument Co., 1315 S. Clarkson St., Denver 10, Colo.
Heiland Research Corp., 130 E. 5th Ave., Denver 9, Colo.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Miller Corp., Wm., 325 N. Halstead Ave., Pasadena 8, Calif.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Sanborn Co., 39 Osborn St., Cambridge 39, Mass. ADV. PG. 127.
Southwestern Industrial Electronic Co., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

OSCILLOSCOPES—Cathode Ray

Beta Electric Corp., 333 E. 103rd St., New York 29, N. Y.
Browning Laboratories, Inc., 750 Main St., Winchester, Mass.
Cambridge Instrument Co., 3786 Grand Central Terminal, New York 17, N. Y.
Cinema-Television, Ltd., Worsley Bridge Rd., London, S. E. 26, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Du Mont Laboratories, Inc., Allen B., Instrument Div., 1000 Main Ave., Clifton, N. J.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Furst Electronics, 20 S. Jefferson St., Chicago 6, Ill.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Lavoie Labs., Morganville, N. J.

Ovens

Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y.
Millen Mfg. Co., James, 150 Exchange St., Malden, Mass.
National Union Radio Corp., 350 Scotland Rd., Orange, N. J.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Plastics & Electronics Co., 272 Northland Ave., Buffalo 8, N. Y.
Radio Corp. of America, RCA Victor Div., Tube Dept., 415 S. Fifth St., Harrison, N. J. ADV. PGS. 91, 106, 137.
Precision Apparatus Co., Inc., 92–27 Horace Harding Blvd., Elmhurst N. Y.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Spencer-Kennedy Labs., Inc., 186 Massachusetts Ave., Cambridge 39, Mass.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Tektronix, Inc., P. O. Box 831, Portland 7, Ore.
Television Equipment Corp., 238 William S., New York, N. Y.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
Waterman Products Co., Inc., 2445–63 Emerald St., Philadelphia 25, Pa. ADV. PGS. 108, 109.

OVENS—Isotemperature

Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Will Corp., Rochester 3, N. Y.

OVENS—Laboratory

Acme Electric Heating Co., Inc., 1205 Washington St., Boston, Mass.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Electric Heat Control Apparatus Co., 247 N. J. R. R. Ave., Newark 5, N. J.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Grieve-Hendry Co., 1101 N. Paulina St., Chicago, Ill.
Humboldt Mfg. Co., 2016 N. Whipple, Chicago, Ill.
Industrial Engineering & Equipment Co., 711 S. Theresa St., St. Louis 3, Mo.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
United States Testing Co., Hoboken, N. J. ADV. PG. 103.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
Will Corp., Rochester 3, N. Y.

OVENS—Vacuum

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.

Phosphors

Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
National Appliance Co., Swan Island, Portland 18, Ore.
Optical Film Engineering Co., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 140.
Stokes Machine Co., F. J., Frankford Station P. O., Philadelphia 20, Pa.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Will Corp., Rochester 3, N. Y.

PHOSPHORS—Scintillation

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Canadian Radium & Uranium Corp., 630 Fifth Ave., New York 20, N. Y.
Eldorado Mining & Refining Ltd., Ottawa, Ontario, Canada. ADV. PG. 114.
Linde Air Products Co., Unit of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass. ADV. PG. 138.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Pilot Chemicals Inc., 47 Felton St., Waltham 54, Mass.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radio Corp. of America, RCA Victor Div., Tube Dept., 415 S. Fifth St., Harrison, N. J. ADV. PGS. 91, 106, 137.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

PHOTOGRAPHIC MATERIALS—Films and Papers for Recording Instruments

du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Delaware
Eastman Kodak Co., Rochester 4, N. Y.

PHOTOGRAPHIC MATERIALS—For Spectrographic Instruments

Eastman Kodak Co., Rochester 4, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Welch Scientific Instrument Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

PHOTOGRAPHIC PLATES & FILM—Nuclear

Eastman-Kodak Co., Rochester 4, N. Y.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Picker X-Ray Products Inc., Glen Cove, N. Y.

PHOTOMETERS—Electric

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Baldwin Instrument Co., Ltd., Brooklands Work, Dartford, Kent, England
Coleman Instruments, Inc., Maywood, Ill.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.

Pipe

Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.

PHOTOMETERS—Flame

Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Perkin-Elmer Corp., Norwalk, Conn.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Will Corp., Rochester 3, N. Y.

PHOTOMETERS—Light-Transmission

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Coleman Instruments Inc., Maywood, Ill.
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood Calif.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Welch Scientific Instrument Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.

PHOTOMICROGRAPHIC EQUIPMENT

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Will Corp., Rochester 3, N. Y.

PIPE—Glass

Able Scientific Glass Apparatus Co., 6859 South Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
Corning Glass Works, Corning, N. Y.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
U. S. Plywood Corp., 55 W. 44th St., New York, 18, N. Y.
Will Corp., Rochester 3, N. Y.

PIPE—Hard Rubber

Goodyear Tire & Rubber Co., Akron, Ohio

Pipe

PIPE—Metal

Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
Alloy Tube Division of Carpenter Steel Co., Union, N. J.
Aluminum Co. of America, 2156 Gulf Bldg., Pittsburgh, Pa.
American Brass Co., 25 Broadway, New York 4, N. Y.
Andel & Co., Inc., 5218 N. Kedzie Ave., Chicago, Ill.
Astell & Co., Inc., John B., 90 West Broadway, New York 7, N. Y.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., Reading, Pa.
Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Chase Brass & Copper Co., Waterbury, Conn.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.
National Lead Co., 111 Broadway, New York 6, N. Y.
Ornamental Iron Work Co., 250 E. Crosier St., Akron 11, Ohio
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.

PIPETTES—Automatic

Eimer & Amend, 635 Greenwich St., New York, N. Y.
Kimble Glass Div., O. I. G., Co., Vineland, N. J.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Will Corp., Rochester 3, N. Y.

PLANCHETS

El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Nuclear Measurements Corps, 2460 Indianapolis Ave., Indianapolis, Ind.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.

PLASTICS—Laminated

Aetna Plywood & Veneer Co., 1738 N. Elston Ave., Chicago 22, Ill.
Continental Diamond Fibre Co., Newark, Delaware
Elm Laboratories, 18 South Broadway, Dobbs Ferry, N. Y.
Emerson & Cuming Co., 126 Massachusetts Ave., Boston 15, Mass.
General Electric Co., Chemical Div., Pittsfield, Mass. ADV. PGS. 75 to 86.
Haveg Corp., Newark 6, Delaware
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Irvington Insulator & Varnish Co., 6 Argyle Terrace, Irvington, N. J.
Keller Products, Inc., Manchester, N. H.
National Vulcanized Fibre Co., Wilmington 99, Del.
Penn Fibre & Specialty Co., 2020 E. Westmoreland St., Philadelphia 34, Pa.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Synthane Corp., River Rd., Oaks, Pa.
Taylor Fibre Co., Norristown, Pa.
Technical Ply-Woods, 228 N. LaSalle St., Chicago, Ill.
U. S. Plywood Corp., 55 W. 44th St., New York 18, N. Y.

Potentiometers

Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Woodall Industries, Inc., Laurel, Miss.

PLASTICS—Protective

Atlas Mineral Products Co., 121 Norman St., Mertztown, Pa.
Bishop Mfg. Corp., 10 Canfield Rd., Cedar Grove, N. J. ADV. PG. 139.
Carboline Co., 7603 Forsythe Blvd., St. Louis 5, Mo.
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Corrosite Corp., Chrysler Bldg., New York 17, N. Y.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Durez Plastics & Chemicals Inc., 1921 Walck Rd., North Tonawanda, N. Y.
Emerson & Cuming Co., 126 Massachusetts Ave., Boston 15, Mass.
General Electric Co., Chemical Div., Pittsfield, Mass. ADV. PGS. 75 to 86.
Gordon-Lacey Chemical Products Co., Inc., 57–02 48th St., Maspeth, N. Y.
Haveg Corp., Newark 6, Delaware
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Irvington Insulator & Varnish Co., 6 Argyle Terrace, Irvington, N. J.
Keller Products, Inc., Manchester, N. H.
Kellogg Co., M. W., Chemical Mfg. Div., P. O. Box 469, Jersey City 3, N. J.
Keystone Electronics Corp., 423 Broome St., New York 12, N. Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
United Chromium, Inc., 100 East 42nd St., New York, N. Y.
U. S. Gasket Co., 602 N. 10th St., Camden, N. J. ADV. PG. 122.
Willson Products, Inc., Reading, Pa.
U. S. Stoneware Co., Akron 9, Ohio

PLATES—Hot

Acme Electric Heating Co., Inc., 1205 Washington St., Boston, Mass.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Industrial Engineering & Equipment Co., 711 S. Theresa St., St. Louis 3, Mo.
Ornamental Iron Work Co., 250 E. Crosier St., Akron 11, Ohio
Watlow Electric Mfg. Co., 2256 Dickson St., St. Louis, Mo.
Will Corp., Rochester 3, N. Y.

POLARIZERS

Airpax Products Co., Middle River, Baltimore 20, Md.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.

POLAROGRAPHS

Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Will Corp., Rochester 3, N. Y.

POTENTIOMETERS

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Centralab Div. Globe Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.

Power Supplies

Clarostat Mfg. Co., Inc., Dover, New Hampshire
Daven Co., 191 Central Ave., Newark 4, N. J.
DeJur-Amsco Corp., 45–01 Northern Blvd., Long Island City 1, N. Y.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Fairchild Camera & Instrument Corp., 88–06 Van Wyck Blvd., Jamaica 1, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Georator Corp, 1820 N. Nash St., Arlington, Va.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
Helipot Corp., 916 Meridian Ave., South Pasadena, Calif.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa. ADV. PG. 111.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Shallcross Mfg. Co., 10 Jackson Ave., Collingdale, Pa.
Sound Apparatus Co., Stirling, N. J.
Tagliabue Instruments Div., Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Technology Instrument Corp., 531 Main St., Acton, Mass.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.
Will Corp., Rochester 3, N. Y.

POWER SUPPLIES—High Voltage

Acme Electric Corp., 31 Water St., Cuba, N. Y.
Airpax Products Co., Middle River, Baltimore 20, Md.
American Communications Corp., 306 Broadway, New York 7, N. Y.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Beta Electric Corp., 333 E. 103rd St., New York 29, N. Y.
Bracke-Seib X-Ray Co., 293 Third Ave., New York 10, N. Y.
Buck Engineering Co., 37–41 Marcy St., Freehold, N. J.
Carnine & Bitter, 12 H St., N.E., Washington 11, D. C.
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.
Cinema-Television Ltd., Worsley Bridge Rd., London S. E. 26, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Communication Measurement Lab., Inc., 120 Greenwich St., New York 6, N. Y.
Communications Co., Inc., 300 Greco Ave., Coral Gables 34, Fla.
Condenser Products Co., 7517 N. Clark St., Chicago 26, Ill.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasedena 8, Calif. ADV. PGS. 98, 99.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.

Power Supplies

Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electro Engineering Works, 6021 College Ave., Oakland 18, Calif.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electronic Associates, Inc., Long Branch, N. J.
Electronic Engineering Corp., 624 Ridge Rd., Lyndhurst, N. J.
Electronic Measurements Co., Red Bank, N. J.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Embassy Engineering Corp., 224 E. 204th St., New York 58, N. Y.
Essex Electronics, Springfield Ave., Berkeley Heights, N. J.
Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J.
Fluke Engineering Co., John, Box 755, Springdale, Conn.
Furst Electronics, 20 S. Jefferson St., Chicago 6, Ill.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
Herbach & Rademan, Inc., 522 Market St., Philadelphia 6, Pa.
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Huggins Laboratories, 734 Hamilton Ave., Menlo Park, Calif.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Inductograph Products, 236 W. 55th St., New York, N. Y. ADV. PG. 134.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Kepco Labs., Inc., 149–14 41st Ave., Flushing, N. Y. ADV. PG. 115.
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Lambda Electronics Corp., 103–02 Northern Blvd., Corona 68, N. Y.
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.
Model Rectifier Corp., 1510 Nostrand Ave., Brooklyn, N. Y.
Network Mfg. Corp., 213 W. 5th St., Bayonne, N. J.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nucleonic Corp. of America, 597 Union St., Brooklyn 31, N. Y.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Oregon Electronic Mfg. Co., 206 S. W. Washington St., Portland 4, Ore.
Polytechnic Research & Development Co., 202 Tillary St., Brooklyn, N. Y.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137.
Sherron Electronics Co., 1201 Flushing Ave., Brooklyn 6, N. Y.
Sierra Electronic Corp., San Carlos, Calif.
Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn. ADV. PG. 110.
Spellman Television Co., Inc., 3029 Webster Ave., Bronx 67, N. Y. ADV. PG. 121.
Sperry Gyroscope Co., Div. of Sperry Corp., Great Neck, N. Y.
Stancil Hoffman Corp., 1016 N. Highland Ave., Hollywood 38, Calif.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.

Power Supplies

POWER SUPPLIES—Regulated

Acme Electric Corp., 31 Water St., Cuba, N. Y.
Air Associates Inc., Teterboro, N. J. ADV. PG. 133.
Airpax Products Co., Middle River, Baltimore 20, Md.
American Communications Corp., 306 Broadway, New York 7, N. Y.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Beta Electric Corp., 333 E. 103rd St., New York 29, N. Y.
Browning Laboratories, Inc., 750 Main St., Winchester, Mass.
Buck Engineering Co., 37–41 Marcy St., Freehold, N. J.
Carnine & Bitter, 12 H St., N.E. Washington 11, D. C.
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.
Cinema-Television, Ltd., Worsley Bridge Rd., London, S. E. 26, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Communication Measurement Lab., Inc., 120 Greenwich St., New York 6, N. Y.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electro Engineering Works, 6021 College Ave., Oakland 18, Calif.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electronic Associates, Inc., Long Branch, N. J.
Electronic Engineering Co., 624 Ridge Rd., Lyndhurst, N. J.
Electronic Measurements Co., Red Bank, N. J.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J.
Fluke Engineering Co., John, Box 755, Springdale, Conn.
Furst Electronics, 20 S. Jefferson St., Chicago 6, Ill.
Gaveco Labs., Inc., 2 East End Ave., New York 21, N. Y.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Herbach & Rademan, Inc., 522 Market St., Philadelphia 6, Pa.
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Inductograph Products, 236 W. 55th St., New York, N. Y. ADV. PG. 134.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Kepco Labs., Inc., 149–14 41st Ave., Flushing, N. Y. ADV. PG. 115.
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Lambda Electronics Corp., 103–02 Northern Blvd., Corona 68, N. Y.
Langevin Mfg. Corp., 37 W. 65th St., New York 23, N. Y.
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.

Preamplifiers

MacLeod & Hanopol, Inc., 10 Joiner St., Charlestown 29, Mass.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Mellaphone Corp., Rochester 2, N. Y.
Model Rectifier Corp., 1510 Nostrand Ave., Brooklyn, N. Y.
Network Mfg. Corp., 213 W. 5th St., Bayonne, N. J.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Instrument & Chemical Co., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Oregon Electronic Mfg. Co., 206 S. W. Washington St., Portland 4, Ore.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.
Polytechnic Research & Development Co., 202 Tillary St., Brooklyn, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radio Corp. of America, RCA Victor Div., Tube Dept., 415 S. Fifth St., Harrison, N. J. ADV. PGS. 91, 106, 137.
Sanborn Co., 39 Osborn St., Cambridge, Mass. ADV. PG. 127.
Sherron Electronics Co., 1201 Flushing Ave., Brooklyn 6, N. Y.
Sierra Electronic Corp., San Carlos, Calif.
Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn. ADV. PG. 110.
Southwestern Industrial Electronic Co., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas
Spellman Television Co., Inc., 3029 Webster Ave., Bronx 67, N. Y. ADV. PG. 121.
Sperry Gyroscope Co., Div. of Sperry Corp., Great Neck, N. Y.
Stancil Hoffman Corp., 1016 N. Highland Ave., Hollywood 38, Calif.
Superior Electric Co., The, 83 Laurel St., Bristol, Conn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Teletronics Laboratory, Inc., 352 Maple Ave., Westbury, N. Y.
Varian Associates, 990 Varian St., San Carlos, Calif.
Varo Mfg. Co., Inc., Box 638, Garland, Texas.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.

PREAMPLIFIERS

Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
American Communications Corp., 306 Broadway, New York 7, N. Y.
Arlington Electric Products, Inc., 500 W. 52nd St., New York, N. Y.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Audio Instrument Co., Inc., 133 W. 14th St., New York 11, N. Y.
Berndt-Bach Inc., 7377 Beverly Blvd., Los Angeles 36, Calif.
Buck Engineering Co., 37–41 Marcy St., Freehold, N. J.
Centralab Div. of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.
Communications Co., Inc., 300 Greco Ave., Coral Gables 34, Fla.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.

Presses

Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electronic Measurements Co., Red Bank, N. J.
Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Furst Electronics, 20 S. Jefferson St., Chicago 6, Ill.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Industrial Control Co., 1462 Straight Path Rd., Wyandanch, N. Y.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.
Network Mfg. Corp., 213 W. 5th St., Bayonne, N. J.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Plastics & Electronics Co., 272 Northland Ave., Buffalo 8, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Remler Co., Ltd., 2101 Bryant St., San Francisco, Calif.
Sanborn Co., 39 Osborn St., Cambridge, Mass. ADV. PG. 127.
Sargent Rayment Co., 212 Ninth St., Oakland, Calif.
Scott, Inc., Hermon Hosmer, 385 Putnam Ave., Cambridge, Mass.
Sierra Electronic Corp., San Carlos, Calif.
Simpson Mfg. Co., Inc., Mark, 32–28 49th St., Long Island City 3, N. Y.
Spencer-Kennedy Labs., Inc., 186 Massachusetts Ave., Cambridge 39, Mass.
Stephens Mfg. Corp., 8538 Warner Drive, Culver City, Calif.
Technology Instrument Corp., 531 Main St., Acton, Mass.
Tektronix, Inc., P. O. Box 831, Portland 7, Ore.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.

PRESSES—Laboratory

American Steel Foundries, Elmes Engineering Division, 1150 Tennessee Ave., Cincinnati 29, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Denison Engineering Co., 1186 Dublin Rd., Columbus, Ohio
Fisher Mfg. Co., Inc., John C. 37–29 9th St., Long Island City 1, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Stokes Machine Co., F. J., Frankford Station P. O., Philadelphia 20, Pa.
Will Corp., Rochester 3, N. Y.

PRESSES—Pelleting

Denison Engineering Co., 1186 Dublin Rd., Columbus, Ohio
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Parr Instrument Co., Moline, Ill.
Stokes Machine Co., F. J., Frankford Station P. O., Philadelphia 20, Pa.
Will Corp., Rochester 3, N. Y.

PROJECTORS—Slide

Clay-Adams Co., 141 E. 25th St., New York 10, N. Y.

Pumps

Gale Dorothea Mechanisms, 81–01 Broadway, Elmhurst, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Leitz, Inc., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 112.
Will Corp., Rochester 3, N. Y.

PSYCHROMETERS—Sling

Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Hill & Co., E. Vernon, 6829 W. Highland Ave., Chicago 31, Ill.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Will Corp., Rochester 3, N. Y.

PULVERIZERS

Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Will Corp., Rochester 3, N. Y.

PUMPS—Centrifugal Vacuum

American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Buckeye Air Compressor Co., 414 Littell Ave., Dayton 4, Ohio
Eberbach Corporation, Ann Arbor, Mich.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Phillips-Drucker, 2245 S. Vandeventer Ave., St. Louis, Mo.
Will Corp., Rochester 3, N. Y.
Worthington Pump & Machinery Corp., 426 Worthington Ave., Harrison, N. J.

PUMPS—Vacuum

Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 1, Wis.
American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Beach-Russ Co., 44 Church St., New York 7, N. Y.
Buckeye Air Compressor Co., 414 Littell Ave., Dayton 4, Ohio
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Distillation Products Industries, Rochester 3, N. Y.
Eck & Krebs, Inc., 27–09 40th Ave., Long Island City 1, N. Y.
Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Eitel-McCullough, Inc., San Bruno, Calif.
Foster Pump Works, Inc., 50 Washington & Front Sts., Brooklyn 1, N. Y.
High Voltage Engineering Corp., 7 University Rd., Cambridge 38, Mass. ADV. PG. 101.
Kinney Mfg. Co., 3614 Washington St., Boston, Mass. ADV. PG. 107.
Litton Industries, San Carlos, Calif.
National Research Corp., 70 Memorial Drive, Cambridge 42, Mass. ADV. PGS. 94, 95.
Optical Film Engineering Co., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 140.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Stokes Machine Co., F. J., Frankford Station P. O., Philadelphia 20, Pa.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

Pyrometers

Whittington Pump & Engineering Corp., 1126 Prospect St., Indianapolis 3, Ind.
Will Corp., Rochester 3, N. Y.
Worthington Pump & Machinery Corp., 426 Worthington Ave., Harrison, N. J.

PYROMETERS

Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
Illinois Testing Labs., Inc., 420 N. LaSalle St., Chicago 10, Ill.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Richards Co., Inc., Arklay S., 12 Winchester St., Newton Highlands 61, Mass.
Taco West Corp., 525 N. Noble St., Chicago 22, Ill.
Tagliabue Instruments Div., Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.

RADIOGRAPHIC EQUIPMENT—Gamma Ray

Eldorado Mining & Refining, Ltd., Ottawa, Ontario, Canada. ADV. PG. 114.
General Electric Co., X-Ray Dept., 4855 Electric Ave., Milwaukee 14, Wis. ADV. PGS. 75 to 86.
High Voltage Engineering Corp., 7 University Rd., Cambridge 38, Mass. ADV. PG. 101.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
St. John C-Ray Laboratory, Califon, N. J.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.

RECORDERS—Fluid Flow

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Brooks Rotameter Co., Box A-1347, Lansdale, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gaveco Labs., Inc., 2 East End Ave., New York 21, N. Y.
Gorrell & Gorrell, Haworth, N. J.
Infilco, Inc., P. O. Box 5033, Tucson, Ariz.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Schaevitz Engineering, Crescent Blvd. at Drexel Ave., Camden 11, N. J.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.

RECORDERS—Humidity & Temperature

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.

Recorders

Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gorrell & Gorrell, Haworth, N. J.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Partlow Corp., The, 2 Campion Rd., New Hartford, N. Y.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Tagliabue Instruments Div. of Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. J.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.
Will Corp., Rochester 3, N. Y.

RECORDERS—Line

Gorrell & Gorrell, Haworth, N. J.

RECORDERS—Liquid Level

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gorrell & Gorrell, Haworth, N. J.
Infilco, Inc., P. O. Box 5033, Tucson, Ariz.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Schaevitz Engineering, Crescent Blvd. at Drexel Ave., Camden 11, N. J.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.

RECORDERS—Milliammeter

Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

RECORDERS—Nuclear Radiation

Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144
Berkeley Scientific Co., 6th & Nevin, Richmond, Calif. ADV. PG. 113.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Electronic Products Co., 111 E. 3rd St., Mt. Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.

Recorders

Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass. ADV. PG. 138.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research Corp., 2707 Federal St., Philadelphia, 46, Pa. ADV. PGS. 88, 89.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill. ADV. PG. 136.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 7, Calif.

RECORDERS—Potentiometer

Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Sound Apparatus Co., Stirling, N. J.
Tagliabue Instruments Div., Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.

RECORDERS—Telemetering

Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Heiland Research Corp., 130 E. 5th Ave., Denver 9, Colo.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Melpar Inc., 452 Swann Ave., Alexandria, Va.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Permaflux Corp., 4900 W. Grand Ave., Chicago 39, Ill.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Stancil-Hoffman Corp., 1016 N. Highland Ave., Hollywood 38, Calif.
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill. ADV. PG. 136.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

Reference Sources & Standards

RECTIFIERS—Metallic

American Communications Corp., 306 Broadway, New York 7, N. Y.
American Television & Radio Co., 300 E. Fourth St., St. Paul 1, Minn.
Bradley Labs., Inc., 82 Meadow St., New Haven 10, Conn.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electro Products Labs., Inc., 4501 N. Ravenswood, Chicago 6, Ill.
Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
International Rectifier Corp., 6809 S. Victoria Ave., Los Angeles 43, Calif.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Mellaphone Corp., Rochester 2, N. Y.
Model Rectifier Corp., 1510 Nostrand Ave., Brooklyn 26, N. Y.
Opad-Green Co., 71 Warren St., New York 7, N. Y.
Syntron Corp., 355 Lexington, Homer City, Pa.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

RECTIFIERS—Tube Rectifying Units

American Communications Corp., 306 Broadway, New York 7, N. Y.
Bracke Seib X-Ray Co., Inc., 293 Third Ave., New York 10, N. Y.
Buck Engineering Co., 37–41 Marcy St., Freehold, N. J.
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.
Communication Measurement Lab., Inc., 120 Greenwich St., New York 6, N. Y.
Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J.
Electro Products Labs., Inc., 4501 N. Ravenswood, Chicago 6, Ill.
Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J.
Furst Electronics, 20 S. Jefferson St., Chicago 6, Ill.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Lambda Electronics Corp., 103–02 Northern Blvd., Corona 68, N. Y.
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.
Mellaphone Corporation, Rochester 2, N. Y.
Nuclear Research Corp., 2707 Federal St., Philadelphia, 46, Pa. ADV. PGS. 88, 89.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Sierra Electronic Corp., San Carlos, Calif.
Stephens Mfg. Corp., 8538 Warner Drive, Culver City, Calif.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

REFERENCE SOURCES & STANDARDS—Radioactive

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

Refractometers

Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.

REFRACTOMETERS

Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Will Corp., Rochester 3, N. Y.

REFRIGERATION EQUIPMENT

Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Bowser Technical Refrigeration Div., Bowser, Inc., Terryville, Conn.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
General Electric Co., Air Conditioning Div., 5 Lawrence St., Bloomfield, N. J. ADV. PGS. 75 to 86.
Harris, Inc., Machine Works, 61 S. E. Yamhill, Portland, Ore.
Little Inc., Arthur D., Cambridge 42, Mass. ADV. PG. 117.
Marlo Coil Co., 6135 Manchester St., St. Louis, Mo.
Sherer-Gillett Co., Marshall, Mich.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.
Trane Co., La Crosse, Wis.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Worthington Pump & Machinery Corp., 426 Worthington Ave., Harrison, N. J.
York Corp., York, Pa.

REGISTERS

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Carnine & Bitter, 12 H St., N.E. Washington 2, D. C.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.

REGULATORS—Voltage

Acme Electric Corp., 31 Water St., Cuba, N. Y.
Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.
Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144
Carnine & Bitter, 12 H St., N.E. Washington 2, D. C.
Cinema-Television Ltd., Worsley Bridge Rd., London S. E. 26, England
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Furst Electronics, 20 S. Jefferson St., Chicago 6, Ill.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Magnetics Inc., 136 Bloomfield Ave., Bloomfield, N. J.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Kepco Labs., Inc., 149–14 41st Ave., Flushing, N. Y. ADV. PG. 115.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.
Magnetic Amplifiers, Inc., 11–54 44th Drive, Long Island City 1, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.

Remote Handling Devices

Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.
Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn. ADV. PG. 110.
Superior Electric Co., The, 83 Laurel St., Bristol, Conn.
Varo Mfg. Co., Inc., Box 638, Garland, Texas
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

RELAYS—Sensitive

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
American Relay & Controls, Inc., 4901 Flournoy St., Chicago 44, Ill.
Arrow-Hart & Hegeman Electric Co., 103 Hawthorne St., Hartford, Conn.
Assembly Products, Inc., Chagrin Falls, Ohio
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
Chandler & Stedman, 398 Newton St., Waltham 54, Mass.
Edison Inc., Thomas A., Instrument Div., West Orange, N. J.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Guardian Electric Co., 1625 W. Walnut St., Chicago 12, Ill.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Price Electric Corp., Frederick, Md.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.
Thermo Instruments Co., 1066 El Camino Real, Belmont, Calif.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.

REMOTE HANDLING DEVICES

Aeronautical Research Labs., General Mills., Inc., 2010 E. Hennepin Ave., Minneapolis 13, Minn. ADV. PG. 96.
Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Carnine & Bitter, 12 H St., N.E., Waashington 2, D. C.
Central Research Laboratories, Inc., Red Wing, Minn.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Eldorado Mining & Refining Ltd., Ottawa, Ontario, Canada. ADV. PG. 114.
Elm Laboratories, 18 South Broadway, Dobbs Ferry, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Gale Dorothea Mechanisms, 81–01 Broadway, Elmhurst, N. Y.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Kupfrian Mfg. Co., 350 State St., Binghamton, N. Y.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Robinette Co., W. C., 802 Fair Oaks Ave., South Pasadena, Calif.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.

Resistance Decades

Servomechanisms, Inc., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 126.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

RESISTANCE DECADES

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Bond Electronics Corp., 88 Franklin Pl., Summit, N. J.
Clarostat Mfg. Co., Inc., Dover, N. H.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago 44, Ill.
Technology Instrument Corp., 531 Main St., Acton, Mass.

RESISTORS

NOTE: Various types of resistors are not indicated in this listing. Contact manufacturer for specific type(s) desired.

Acme Electric Heating Co., Inc., 1205 Washington St., Boston, Mass.
Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Bond Electronics Corp., 88 Franklin Pl., Summit, N. J.
Carborundum Co., Globar Div., Niagara Falls, N. Y.
Centralab Division, Globe-Union Inc., 900 Keefe Ave., Milwaukee 1, Wis.
Cima Corp., 91 Boylston St., Jamaica Plains 30, Mass.
Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio
Clarostat Mfg. Co., Inc., Dover, N. H.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Daven Co., 191 Central Ave., Newark 4, N. J.
Electrical Reactance Corp., Seneca Ave., Olean, N. Y.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Erie Resistor Corp., 644 W. 12th St., Erie, Pa.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hardwick, Hindle, Inc., 40 Hermon St., Newark 5, N. J.
Instrument Resistors Co., 1036 Commerce Ave., Union, N. J.
International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa. ADV. PG. 111.
Keystone Carbon Co., Inc., Saint Marys, Pa.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Mepco Inc., 35–37 Abbett Ave., Morristown, N. J.
Micro-Circuits Co., New Buffalo, Mich.
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago 44, Ill.
Plastics & Electronics Co., 272 Northland Ave., Buffalo 8, N. Y.
Resistance Products Co., 714 Race St., Harrisburg 2, Pa.
Resistors, Inc., 5226 W. 26th St. Chicago 50, Ill.
Shallcross Mfg., Co., 10 Jackson Ave., Collingdale, Pa.
Sprague Electric Co., North Adams, Mass. ADV. PG. 102.
Stackpole Carbon Co., St. Marys, Pa.

Scalers

Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Ward Leonard Electric Co., 21 South St., Mt. Vernon, N. Y.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 135.
White Dental Mfg. Co., S. S., 10 East 40th St., New York 16, N. Y.
Wirt Co., 5221 Greene St., Philadelphia 44, Pa.

RHEOSTATS

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
Clark Controller Co., 1146 152nd St., Cleveland 10, Ohio
Clarostat Mfg. Co., Inc., Dover, N. H.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
DeJur-Amsco Corp., 45–01 Northern Blvd., Long Island City 1, N. Y.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hardwick, Hindle, Inc., 40 Hermon St., Newark 5, N. J.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago 44, Ill.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Vulcan Electric Co., 88 Holten St., Danvers, Mass.
Ward Leonard Electric Co., 21 South St., Mt. Vernon, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

RINGS—Absorption Fractionating

Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
U. S. Stoneware Co., Akron 9, Ohio

SAMPLE HOLDERS & CHANGERS

Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 144.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Nuclear Instrument & Chemical Co., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

SCALERS

Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Berkeley Scientific Co., 6th & Nevin, Richmond, Calif. ADV. PG. 113.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.

Scales

El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Herbach & Rademan, Inc., 522 Market St., Philadelphia 6, Pa.
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis, Ind.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y. ADV. PG. 139.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Special Instrument Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120
Will Corp., Rochester 3, N. Y.

SCALES—Laboratory

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Exact Weight Scale Co., 1017 W. 5th Ave., Columbus 8, Ohio
Humboldt Mfg. Co., 2016 N. Whipple, Chicago, Ill.
Ohaus Scale Co., 1050 Commerce Ave., Union, N. J.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

SCALES—Platform

Exact Weight Scale Co., 1017 W. Fifth Ave., Columbus 8, Ohio
Humbolt Mfg. Co., 2016 N. Whipple, Chicago, Ill.
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill. ADV. PG. 136.

SCREENS—Laboratory

Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Humboldt Mfg. Co., 2016 N. Whipple, Chicago, Ill.
Newark Wire Cloth Company, 351 Verona Ave., Newark 4, N. J.
Will Corp., Rochester 3, N. Y.

SCREENS, SIEVES

Cave & Co., Ltd., 567 Hornby St., Vancouver, B. C., Canada
Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.

Spectrographs

Humboldt Mfg. Co., 2016 N. Whipple, Chicago, Ill.
Newark Wire Cloth Company, 351 Verona Ave., Newark 4, N. J.
Will Corp., Rochester 3, N. Y.

SERVOMECHANISMS

See Controls, Servo

SHAKERS

Clay-Adams Co., 141 E. 25th St., New York 10, N. Y.
Eberbach Corporation, Ann Arbor, Mich.
Humboldt Mfg. Co., 2016 N. Whipple, Chicago, Ill.
International Equipment Co., 1284 Soldiers Field Rd., Boston 35, Mass.
Newark Wire Cloth Company, 351 Verona Ave., Newark 4, N. J.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 6, Pa.
Will Corp., Rochester 3, N. Y.

SHEETS—Hard Rubber

Goodyear Tire & Rubber Co., Akron, Ohio

SHIELDING EQUIPMENT

See also—Glass—Radiation Shielding
Andel & Co., Inc., 5218 N. Kedzie Ave., Chicago, Ill.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Eldorado Mining & Refining Ltd., Ottawa, Ontario, Canada. ADV. PG. 114.
Keller Products, Inc., Manchester, N. H.
Metal Textile Corp., 647 E. First Ave., Roselle, N. J.
National Lead Co., 111 Broadway, New York 6, N. Y.
Nuclear Research Corp., 2707 Federal St., Philadelphia, 46, Pa. ADV. PGS. 88, 89.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120

SILICONE GREASE

American Phenolic Corp., 1530 S. 5th Ave., Chicago 50, Ill. ADV. PG. 140.
Dow Chemical Co., Midland, Mich.
Dow Corning Corp., Midland, Mich.
General Electric Co., Chemical Div., Pittsfield, Mass. ADV. PGS. 75 to 86.
Will Corp., Rochester 3, N. Y.

SILICONE RUBBER

Connecticut Hard Rubber Co., New Haven, Conn.
Dow Chemical Co., Midland, Mich.
Dow Corning Corp., Midland, Mich.
General Electric Co., Chemical Div., Pittsfield, Mass. ADV. PGS. 75 to 86.

SPECTROGRAPHS

Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.
Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

Spectrometers

Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Perkin-Elmer Corp., Norwalk, Conn.
Will Corp., Rochester 3, N. Y.

SPECTROMETERS

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.
Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Perkin-Elmer Corp., Norwalk, Conn.
Rudolph & Sons, O. C., P. O. Box 446, Caldwell, N. J.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Will Corp., Rochester 3, N. Y.

SPECTROMETERS—Mass

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif. ADV. PGS. 98, 99.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Hathaway Instrument Corp., 1315 S. Clarkson St., Denver 10, Colo.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Vacuum-Electronic Engineering Co., 756 Third Ave., Brooklyn 32, N. Y. ADV. PG. 128.

SPECTROPHOTOMETERS

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Applied Physics Corp., 362 W. Colorado St., Pasadena 1, Calif.
Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.
Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
Coleman Instruments, Inc., Maywood, Ill.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Jarrell-Ash Co., 365 Newberry St., Boston 16, Mass.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Perkin-Elmer Corp., Norwalk, Conn.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Will Corp., Rochester 3, N. Y.

Stirrers

STANDARDS—Gamma Ray

See Reference Sources & Standards—Radioactive

STANDARDS—Radioactive

Clarkstan Corp., 11921 SW Pico Blvd., Los Angeles 64, Calif.
Eldorado Mining & Refining Ltd., Ottawa, Ontario, Canada. ADV. PG. 114.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
U. S. Radium Corp., 535 Pearl St., New York 7, N. Y.

STANDS—Titration

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Will Corp., Rochester 3, N. Y.

STERILIZERS

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Pelton & Crane Co., 632 Harper Ave., Detroit, Mich.
Will Corp., Rochester 3, N. Y.

STILLS—Distilled Water

American Copper & Brass Works, Cincinnati 2, Ohio
Barnstead Still & Sterlizer Co., 222 Lanesville Terrace, Forest Hills, Boston 31, Mass.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Illinois Water Treatment Co., 858 Cedar St., Rockford, Ill.
Stokes Machine Co., F. J., Frankford Station P. O., Philadelphia 20, Pa.
Will Corp., Rochester 3, N. Y.

STILLS—Laboratory

Able Scientific Glass Apparatus Co., 6859 S. Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
American Copper & Brass Works, Inc., Cincinnati 2, Ohio
Barnstead Still & Sterlizer Co., 222 Lanesville Terrace, Forest Hills, Boston 31, Mass.
Corning Glass Works, Corning, N. Y.
Distillation Products Industries, Rochester 3, N. Y.
Eberbach Corporation, Ann Arbor, Mich.
Eck & Krebs, Inc., 27–09 40th Ave., Long Island City 1, N. Y.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Illinois Water Treatment Co., 858 Cedar St., Rockford, Ill.
Pfaudler Co., East Ave., & Clark St., Rochester, N. Y.
Stokes Machine Co., F. J., Frankford Station P. O., Philadelphia 20, Pa.
Will Corp., Rochester 3, N. Y.

STIRRERS

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.

Survey Apparatus

Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
General Mixing Equipment Co., 411 N. 3rd St., Philadelphia, Pa.
Industrial Products Engineering Co., 44–25 Hunter St., Long Island City, N. Y.
Mixing Equipment Co., 192 Mt. Read Blvd., Rochester 11, N. Y.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Will Corp., Rochester 3, N. Y.

SURVEY APPARATUS

Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Herbach & Rademan, Inc., 522 Market St., Philadelphia 6, Pa.
New London Instrument Co., P. O. Box 189, New London, Conn.
Nuclear Research Corp., 2707 Federal St., Philadelphia 46, Pa. ADV. PGS. 88, 89.
Precision Radiation Instruments, 413 W. Jefferson Blvd., Los Angeles 16, Calif.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 140.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.

SURVEY METERS

Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa. ADV. PGS. 92, 93.
Espey Mfg. Co., Inc., 528 E. 72nd St., New York 21, N. Y.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86.
Interelectronics Corp., 2432 Grand Concourse, New York, 58, N. Y.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover.
Nuclear Research & Development Inc., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 134.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y.
Nuclear Research Corp., 2707 Federal St., Philadelphia, 46, Pa. ADV. PGS. 88, 89.
Precision Radiation Instruments 413 W. Jefferson Blvd., Los Angeles 16, Calif.
Ohmart Corp., 2347 Ferguson Ave., Cincinnati 5, Ohio. ADV. PG. 123.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Radiac Co., 489 Fifth Ave., New York 17, N. Y. ADV. PG. 120.
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.

Telemetering Systems

Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Special Instruments Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.
Will Corp., Rochester 3, N. Y.

TECHNICAL BOOKS—Publishers

Academic Press Co., 125 E. 23rd St., New York 10, N. Y.
Addison Wesley Press, Kendall Square, Cambridge 42, Mass.
Bender & Co., Matthew, 149 Broadway, New York 6, N. Y.
Blakiston Co., 1012 Walnut St., Philadelphia 5, Pa.
Boyce-Roche Book Co., 460 Bloomfield Ave., Montclair, N. J.
Dover Publications, 1780 Broadway, New York 18, N. Y.
Electronics Research Publishing Co., Inc., 480 Canal St., New York 13, N. Y.
Institute of Radio Engineers, Inc., 1 E. 79th St., New York, N. Y.
Instruments Publishing Co., 921 Ridge Ave., Pittsburgh 12, Pa.
McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y.
Murray Hill Books Inc., 232 Madison Ave., New York, N. Y.
Philosophical Library, 15 E. 40th St., New York, N. Y.
Rider Publications Inc., John F., 480 Canal St., New York 13, N. Y.
Sams Co., Inc., Howard W., 2201 E. 46th St., Indianapolis 5, Ind.
Universal Scientific Co., Vincennes, Ind.
University of Chicago Press, 5750 Ellis Ave., Chicago 37, Ill.
Van Nostrand Co., Inc., D., 250 Fourth Ave., New York 3, N. Y.
Wiley & Sons Inc., John, 440 Fourth Ave., New York, N. Y.

TELEMETERING SYSTEMS—Electronic

Aeronautical Research Labs., General Mills., Inc., 2010 E. Hennepin Ave., Minneapolis 13, Minn. ADV. PG. 96.
Air Associates, Inc., Teterboro, N. J. **ADV. PG. 133.**
Applied Science Corp. of Princeton, P. O. Box 44, Princeton, N. J.
Arlington Electric Products Inc., 500 W. 52nd St., New York, N. Y.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Carnine & Bitter, 12 H St., N.E., Washington 11, D. C.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Communications Co., Inc., 300 Greco Ave., Coral Gables 34, Fla.
Diamond Power Specialty Corp., Lancaster, Ohio
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Electro-Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Hart Associates, S. V., 804 Monroe St. Ann Arbor, Mich.
Hastings Instrument Co., Box 1275, Hampton, Va.

Telephone Equipment

Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Melpar Inc., 452 Swann Ave., Alexander, Va.
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.
Rosen Engineering Products, Inc., Raymond, 32nd & Walnut St., Philadelphia 4, Pa.
Sierra Electronic Corp., San Carlos, Calif.
Swartout Co., 18547 Euclid Ave., Cleveland, Ohio
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

TELEPHONE EQUIPMENT—Sound Powered

U. S. Instrument Corp., 409 Broad St., Summit, N. J.

TELEVISION SYSTEMS—Industrial

Berndt-Bach Inc., 7377 Beverly Blvd., Los Angeles 36, Calif.
Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.
Carnine & Bitter, 12 H St., N.E., Washington 2, D. C.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E., 26, England
Diamond Power Specialty Corp., Lancaster, Ohio
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
DuMont Laboratories, Inc., Allen B., Instrument Div., 1000 Main Ave., Clifton, N. J.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137.
Television Equipment Corp., 238 Williams St., New York, N. Y.

TESTERS—Hardness

Eberbach Corporation, Ann Arbor, Mich.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Infilco, Inc., P. O. Box 5033, Tucson, Ariz.

TESTERS—Tube & Multimeter

Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Kelley-Koett Instrument Co., 930 York St., Cincinnati 14, Ohio
Precision Apparatus Co., Inc., 92–97 Horace Harding Blvd., Elmhurst, N. Y.
Radio Corp. of America, RCA Victor Div., Tube Dept., 415 S. Fifth St., Harrison, N. J. ADV. PGS. 91, 106, 137.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Simpson Electric Co., Div., of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.

Thermocouples

Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio

TESTERS—Vacuum

Distillation Products Industries, Rochester 3, N. Y.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
National Research Corp., 70 Memorial Drive, Cambridge 42, Mass. ADV. PGS. 94, 95.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden N. J. ADV. PGS. 91, 106, 137.
Simpson Electric Co., Div., of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Whittington Pump & Engineering Corp., 1126 Prospect St., Indianapolis 3, Ind.

TESTERS—Voltage

Associated Research, Inc., 3758 W. Belmont, Chicago, Ill.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Instrument Laboratories, 315 W. Walton Place, Chicago, Ill.
International Instruments, Inc., P. O. Box 2954, New Haven 15, Conn.
Martindale Electric Co., Hird Ave., Cleveland 7, Ohio
National Union Radio Corp., 350 Scotland Rd., Orange, N. J.
Network Mfg. Corp., 213 W. 5th St., Bayonne, N. J.
Optical Film Engineering Co., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 140.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radio Corp. of America, RCA Victor Div., Tube Dept., 415 S. Fifth St., Harrison, N. J. ADV. PGS. 91, 106, 137.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
Vacuum-Electronic Engineering Co., 756 Third Ave., Brooklyn 32, N. Y. ADV. PG. 128.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

THERMOCOUPLES

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark, N. J.
American Thermo Electric Co., 67 E. 8th St., New York 3, N. Y.
Assembly Products, Inc., Chagrin Falls, Ohio
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Englehard, Inc., Charles, 850 Passaic Ave., East Newark, N. J.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.

Thermometers

Hasting Instrument Co., Box 1275, Hampton, Va.
Illinois Testing Labs., Inc., 420 N. LaSalle St., Chicago 10, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Liston-Becker Instrument Co., Inc., 20 Beckley Ave., Stamford, Conn.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Perkin-Elmer Corp., Norwalk, Conn.
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Richards Co., Inc., Arklay S., 12 Winchester St., Newton Highlands 61, Mass.
Sensitive Research Instrument Corp., 9 Elm Ave., Mt. Vernon, N. Y.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Tagliabue Instruments Div. of Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Wheelco Instruments Co., 847 W. Harrison St., Chicago 7, Ill.
Will Corp., Rochester 3, N. Y.

THERMOMETERS—Laboratory

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Eimer & Amend, 635 Greenwich St., New York, N. Y.
Ever Ready Thermometer Co., 1118 Bedford Ave., Brooklyn 5, N. Y.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill.
H-B Instrument Co., 2633 Trenton Ave., Philadelphia 25, Pa.
Hill & Co., E. Vernon, 6829 W. Highland Ave., Chicago 31, Ill.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Miller & Weber, Inc., 71–14 Myrtle Ave., Glendale 27, N. Y.
Nurnberg Thermometer Co., Inc., 124 Livingston St., Brooklyn 2, N. Y.
Palmer Thermometers, Inc., 2501 Norwood Ave., Cincinnati, Norwood 12, Ohio
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia 30, Pa.
Ruehfel Co., Inc., 107–20 101st Ave., Richmond Hill, N. Y.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Tagliabue Instruments Div. of Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Will Corp., Rochester 3, N. Y.

TIMERS—Automatic Reset

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England
Cramer Co., Inc., R. W., Centerbrook, Conn.
Gale Dorothea Mechanisms, 81–01 Broadway, Elmhurst, N. Y.

Timers

Gaveco Labs., Inc., 2 East End Ave., New York 21, N. Y.
General Controls Co., Glendale 1, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gorrell & Gorrell, Haworth, N. J.
Guardian Electric Co., 1625 W. Walnut St., Chicago 12, Ill.
Haydon Mfg. Co., Inc., 584 Elm St., Torrington, Conn.
Paragon Electric Company, Two Rivers, Wisconsin
Partlow Corp., The, 2 Campion Rd., New Hartford, N. Y.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Photobell Company, 116 Nassau St., New York 7, N. Y.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y. ADV. PG. 139.
Ruehfel Co., Inc., 107–20 101st Ave., Richmond Hill, N. Y.
Scientific Services, Inc., 1417 Solano Ave., Albany, Calif.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

TIMERS—Electric

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Berkeley Scientific Co., 6th & Nevin, Richmond, Calif. ADV. PG. 113.
Carnine & Bitter, 12 H St., N.E., Washington 2, D. C.
Cinema-Television Ltd., Worsley Bridge Rd., London S. E. 26, England
Cramer Co., Inc., R. W., Centerbrook, Conn.
Cutler-Hammer Inc., 412 N. 12th St., Milwaukee 1, Wis.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Gale Dorothea Mechanisms, 81–01 Broadway, Elmhurst, N. Y.
General Control Company, 1200 Soldiers Field Rd., Boston 34, Mass.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gorrell & Gorrell, Haworth, N. J.
Guardian Electric Co., 1625 W. Walnut St., Chicago 12, Ill.
Haydon Mfg. Co., Inc., 584 Elm St., Torrington, Conn.
Paragon Electric Co., Two Rivers, Wisconsin
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Photobell Company, 116 Nassau St., New York 7, N. Y.
Rhodes Inc., M. H. 30 Bartholomew Ave., Hartford, Conn.
Sangamo Electric Co., Springfield, Ill.
Standard Electric Time Co., 89 Logan St., Springfield, Mass.
Tork Clock Co., Inc., Mount Vernon, N. Y.
Will Corp., Rochester 3, N. Y.

TIMERS—Electronic

Aeronautical Research Labs., General Mills, Inc., 2010 E. Hennepin Ave., Minneapolis 13, Minn. ADV. PG. 96.
Air Associates, Inc., Teterboro, N. J. ADV. PG. 133.
Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.

Timers

American Chronoscope Corp., 316 W. First St., Mount Vernon, N. Y.
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Berkeley Scientific Co., 6th & Nevin, Richmond, Calif. ADV. PG. 113.
Carnine & Bitter, 12 H St., N.E., Washington 2, D. C.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
General Control Company, 1200 Soldiers Field Rd., Boston 34, Mass.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Guardian Electric Co., 1625 W. Walnut St., Chicago 12, Ill.
Hart Associates, S. V., 804 Monroe St., Ann Arbor, Mich.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.
Magnetic Amplifiers, Inc., 11-54 44th Drive, Long Island City 1, N. Y.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Photobell Company, 116 Nassau St., New York 7, N. Y.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y. ADV. PG. 139.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137.
Ripley Co., Inc., 22 W. First St., Mt. Vernon, N. Y.
Wilson Co., G. C., Passaic Ave, Chatham, N. J.

TIMERS—Precision

American Chronoscope Corp., 316 W. First St., Mount Vernon, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Carnine & Bitter, 12 H St., N.E., Washington 2, D. C.
Clebar Watch Agency, 521 Fifth Ave., New York, N. Y.
Cramer Co., Inc., R. W., Centerbrook, Conn.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Gorrell & Gorrell, Haworth, N. J.
Laboratory for Electronics, Inc., 11 Leon St., Boston 15, Mass.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y. ADV. PG. 139.
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137.
Standard Electric Time Co., 89 Logan St., Springfield, Mass.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

Transformers

TIMERS—Printing Interval

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Carnine & Bitter, 12 H St., N.E., Washington 11, D. C.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Rhodes, Inc., M. H., 30 Bartholomew Ave., Hartford, Conn.
Special Instrument Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill. ADV. PG. 136.
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120.

TITRATORS

Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif.
Coleman Instruments, Inc., Maywood, Ill.
Will Corp., Rochester 3, N. Y.

TRANSFORMERS—Constant Voltage

Acme Electric Corp., 31 Water St., Cuba, N. Y.
Airdesign Inc., 241 Fairfield Ave., Upper Darby, Pa.
Airpax Products Co., Middle River, Baltimore 20, Md.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electro Engineering Works, 6021 College Ave., Oakland 18, Calif.
Electronic Transformer Co., Inc., 215 W. 25th St., New York, N. Y.
General Controls Co., Glendale 1, Calif.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
Kenyon Transformer Co., Inc., 840 Barry St., New York 59, N. Y.
Permaflux Corp., 4900 W. Grand Ave., Chicago 39, Ill.
Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.
Standard Transformer Corp., 3580 N. Elston Ave., Chicago 18, Ill.
United Transformer Co., 150 Varick St., New York 13, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Will Corp., Rochester 3, N. Y.

TRANSFORMERS—Pulse

Acme Electric Corp., 31 Water St., Cuba, N. Y.
Airdesign Inc., 241 Fairfield Ave., Upper Darby, Pa.
Airpax Products Co., Middle River, Baltimore 20, Md.
Engineering Research Associates Inc., 1902 W. Minnehaha Ave., St. Paul 4, Minn.
Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y.
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
Kenyon Transformer Co., Inc., 840 Barry St., New York 59, N. Y.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass. ADV. PG. 100.
Sperry Gyroscope Co., Div. of The Sperry Corp., Great Neck, N. Y.

Transformers

Standard Transformer Corp., 3580 N. Elston Ave., Chicago 18, Ill.
U. S. Electronics Corp., 276 Warren St., Lyndhurst, N. J.
United Transformer Co., 150 Varick St., New York 13, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

TRANSFORMERS—Variable

Acme Electric Corp., 31 Water St., Cuba, N. Y.
Airdesign Inc., 241 Fairfield Ave., Upper Darby, Pa.
Airpax Products Co., Middle River, Baltimore 20, Md.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electronic Transformer Co., Inc., 215 W. 25th St., New York, N. Y.
Epco Products, Inc., 2500 Atlantic Ave., Brooklyn 7, N. Y.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Opad-Green Co., 71 Warren St., New York, N. Y.
Standard Transformer Corp., 3580 N. Elston Ave., Chicago 18, Ill.
Superior Electric Co., 83 Laurel St., Bristol, Conn.
United Transformer, Co. 150 Varick St., New York 13, N. Y.

TRANSFORMERS—Voltage Regulating

Acme Electric Corp., 31 Water St., Cuba, N. Y.
Airdesign Inc., 241 Fairfield Ave., Upper Darby, Pa.
Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 1, Wis.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electronic Transformer Co., Inc., 215 W. 25th St., New York, N. Y.
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86.
General Magnetics, Inc., 136 Bloomfield Ave., Bloomfield, N. J.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Langevin Mfg. Corp., 37 W. 65th St., New York 23, N. Y.
Magnetic Amplifiers, Inc., 11–54 44th Drive, Long Island City 1, N. Y.
Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.
United Transformer Co., 150 Varick St., New York 13, N. Y.
Will Corp., Rochester 3, N. Y.

TUBES—Electron

(a) Electrometer
(b) Geiger
(c) Ignitron
(d) Mass Spectrometer
(e) Photomultiplier
(f) Power
(g) Receiving
(h) Rectifying
(i) Thyratron
(j) Voltage Regulating
(k) X-Ray

Able Scientific Glass Apparatus Co., 6859 S. Anthony Ave., Chicago 37, Ill. ADV. PG. 128. b
Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y. b-f-h-i-j-k
Anton Electronic Labs., Inc., 1226–38 Flushing Ave., Brooklyn 37, N. Y. **ADV. PG. 144.** b-i
Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 129. b
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y. b
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England a
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J. f-h-i-j
Cinema-Television, Ltd., Worsley Bridge Rd., London, S. E. 26, England b-e-h
Cole, Ltd., E. K., Electronics Div., Malmesbury, Wiltshire, England a-b
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif. ADV. PGS. 98, 99. d
Cyclotron Specialities Co., Morago 8, Calif. b
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J. b-g-h-i-j
Eitel-McCullough, Inc., San Bruno, Calif. f-h
Electric & Musical Industries Ltd., Hayes, Middlesex, England e-f-g-h-i-j
Electronic Products Co., 111 E. 3rd St., Mt. Vernon, N. Y. b-j
Electrons, Inc., 127 Sussex Ave., Newark 4, N. J. f-h-i
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa., ADV. PGS. 92, 93. b
Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J. f-h-i
General Electric Co., Apparatus Marketing Div., Schenectady 5, N. Y. ADV. PGS. 75 to 86. d
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y. ADV. PGS. 75 to 86. b-c-e-f-g-h-i-j
General Electric Co., X-Ray Dept., 4855 Electric Ave., Milwaukee, Wis. ADV. PG. 75 to 86. k
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. b
Georator Corp., 1820 N. Nash St., Arlington, Va. b
Heintz & Kaufman Div., of The Robert Dollar Co., 947 Broadway, Redwood City, Calif. f-h
Herbach & Rademan, Inc., 522 Market St., Philadelphia 6, Pa. b
High Voltage Engineering Corp., 7 University Rd., Cambridge 38, Mass. ADV. PG. 101. k
Hytron Radio & Electronics Co., A Division of Columbia Broadcasting System, Inc., Salem, Mass. f-g-h-i
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass. k
Lewis & Kaufman, Inc., Los Gatos, Calif. f-h
Litton Industries, San Carlos, Calif. f
Machlett Laboratories, Inc., 1063 Hope St., Springdale, Conn. f-h-i-j-k
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y. a
National-Union Radio Corp., 350 Scotland Rd., Orange, N. J. f-g
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y. b-k
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. ADV. PG. 130.
Nuclear Instrument & Chemical Corp., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover. b
Nuclear Research Corp., 2707 Federal St., Philadelphia, 46, Pa. ADV. PGS. 88, 89.
Nucleonic Corp. of America, 497 Union St., Brooklyn 31, N. Y. b-j
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116. j
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa. e
Photovolt Corp., 95 Madison Ave., New York 16, N. Y. e
Picker X-Ray Corp., 300 Fourth Ave., New York 10, N. Y. k
Process & Instruments Co., 60 Greenpoint Ave., Brooklyn 22, N. Y. d
R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif. e
Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover. b

Tubing

Radiation Instrument Development Lab., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. 132. b
Radio Corp. of America, RCA Victor Div., Engineering Products Dept., Front & Cooper Sts., Camden, N. J. ADV. PGS. 91, 106, 137. e-f-g-h-i-j
Radio Corp. of America, RCA Victor Div., Tube Dept., 415 S. Fifth St., Harrison, N. J. ADV. PGS. 91, 106, 137. c-e-f-g-h-i-j
Raytheon, Mfg. Co., Special Tube Section, 55 Chapel St., Newton 58, Mass. ADV. PG. 100. a-b-f-g-h-i
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y. e-g-h-i-j
Technical Associates, Inc., 3730 San Fernando Rd., Glendale 4, Calif. ADV. PG. 119. b
Tracerlab, Inc., 130 High St., Boston 10, Mass. ADV. PG. 120. b
Tung-Sol Electric Inc., 95 Eighth Ave., Newark 4, N. J. f-g-h-j
Universal X-Ray Products Inc., 1140 N. Western Ave., Chicago 22, Ill. k
Vacuum-Electronic Engineering Co., 756 Third Ave., Brooklyn 32, N. Y. ADV. PG. 129. d
Varian Associates, 990 Varian St., San Carlos, Calif. f-g
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover. a-b-h-j
Western Radiation Lab., 1107 W. 24th St., Los Angeles 7, Calif. b
Westinghouse Electric Corp., Electronic Tube Sales Dept., Bloomfield, N. J. a-b-c-e-h-i-j-k
Wood Counter Laboratory, N., 5646 Harper Ave., Chicago 37, Ill. b

TUBING—Glass

Bache & Co., Semon, 636 Greenwich St., New York 14, N. Y.
Corning Glass Works, Corning, N. Y.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Kimble Glass Div., O. I. G. Co., Vineland, N. J.
Mitchell-Rand Insulation Co., Inc., 51 Murray St., New York 7, N. Y.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
U. S. Plywood Corp., 55 W. 44th St., New York 18, N. Y.
Will Corp., Rochester 3, N. Y.

TUBING—Metal and Alloy

Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
Alloy Tube Division of Carpenter Steel Co., Union, N. J.
Aluminum Co. of America, 2156 Gulf Bldg., Pittsburgh, Pa.
American Brass Co., 25 Broadway, New York 4, N. Y.
Andel & Co., Inc., 5218 N. Kedzie Ave., Chicago, Ill.
Astell & Co., Inc., John B., 90 West Broadway, New York 7, N. Y.
Bethlehem Steel Co., Bethlehem, Pa.
Bishop & Co., J., Malvern, Pa.
Bridgeport Brass Co., 30 Grand St., Bridgeport 2, Conn.
Carpenter Steel Co., Reading, Pa.
Chase Brass & Copper Co., Waterbury 20, Conn.
Driver-Harris Co., Harrison, N. J.
Haynes Stellite Division, Union Carbide & Carbon Corp., Kokomo, Indiana
International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.
National Lead Co., 111 Broadway, New York 6, N. Y.
Precision Tube Co., Inc., 3828 Terrace St., Philadelphia 28, Pa.
Revere Copper & Brass, Inc., 230 Park Avenue, New York 17, N. Y.
Superior Tube Co., Norristown, Pa. ADV. PG. 125.

Valves

TUBING—Plastic

Clay-Adams Co., 141 E. 25th St., New York 10, N. Y.
Continental Diamond Fibre Co., Newark, Delaware
Haveg Corp., Newark 6, Delaware
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.
General Electric Co., Chemical Div., Pittsfield, Mass. ADV. PGS. 75 to 86.
Mitchell-Rand Insulation Co., Inc., 51 Murray St., New York 7, N. Y.
National Varnished Products Corp., 211 Randolph Ave., Woodbridge, N. J.
National Vulcanized Fibre Co., Wilmington 99, Del.
Synthane Corp., River Rd., Oaks, Pa.
U. S. Gasket Co., 602 N. 10th St., Camden, N. J. ADV. PG. 122.
U. S. Plywood Corp., 55 W. 44th St., New York 18, N. Y.
U. S. Stoneware Co., The, Akron 9, Ohio
Will Corp., Rochester 3, N. Y.

TUBING—Rubber

General Electric Co., Chemical Div., Pittsfield, Mass. ADV. PGS. 75 to 86.
Goodrich Co., B. F., 448 S. Main St., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Will Corp., Rochester 3, N. Y.

TUBING—Seamless

Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
Aluminum Co. of America, 2156 Gulf Bldg., Pittsburgh, Pa.
American Brass Co., 25 Broadway, New York 4, N. Y.
Astell & Co., Inc., John B., 90 West Broadway, New York 7, N. Y.
Bridgeport Brass Co., 30 Grand St., Bridgeport 2, Conn.
International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.
Precision Tube Co., Inc., 3828 Terrace St., Philadelphia 28, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Superior Tube Co., Norristown, Pa. ADV. PG. 125.
Will Corp., Rochester 3, N. Y.

UTENSILS—Laboratory

Eberbach Corporation, Ann Arbor, Mich.
Goodrich Co., B. F., 448 S. Main St., Akron, Ohio
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill. ADV. PG. Inside Back Cover.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Will Corp., Rochester 3, N. Y.

VALVES—Control Liquid

Anderson Valve Corp., Marion, Ind.
Aquatrol, Inc., 511 N. Peoria St., Chicago 22, Ill.
Associated Valve & Engineering Co., 1150 W. Marquette Rd., Chicago 21, Ill.
Astell & Co., Inc., John B., 90 West Broadway, New York 7, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y. ADV. PGS. 104, 105.
Caltron Co., 1406 S. Hobart Blvd., Los Angeles 6, Calif.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Denison Engineering Co., 1186 Dublin Rd., Columbus, Ohio
Fairbanks Co., 393 Lafayette St., New York 3, N. Y.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.

Valves

General Controls Co., Glendale 1, Calif.
Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I.
Hoppe Engineering Co., 1 High, Greensboro, Ind.
Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago 7, Ill.
Inflico, Inc., P. O. Box 5033, Tucson, Ariz.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Keckley Co., O. C., 400 Madison St., Chicago 6, Ill.
Kieley & Mueller, Inc., North Bergen, N. J.
Kunkel Valve Co., 125 S. Clinton St., Fort Wayne 2, Ind.
Madden & Co., P. E., 1543 Morse Ave., Chicago 26, Ill.
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Roberts Aves., Philadelphia 44, Pa.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Trane Co., La Crosse, Wis.

VALVES—Vacuum

Associated Valve & Engineering Co., 1150 Marquette Rd., Chicago 21, Ill.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Distillation Products Industries, Rochester 3, N. Y.
Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J.
Eitel-McCullough, Inc., San Bruno, Calif.
Heintz & Kaufman Div., Robert Dollar Co., 947 Broadway, Redwood City, Calif.
High Voltage Engineering Corp., 7 University Rd., Cambridge 38, Mass. ADV. PG. 101.
Keckley Co., O. C., 400 W. Madison St., Chicago 6, Ill.
Kieley & Mueller, Inc., North Bergen, N. J.
National Research Corp., 70 Memorial Drive, Cambridge 42, Mass. ADV. PGS. 94, 95.
Optical Film Engineering Co., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 140.
Stokes Machine Co., F. J., Frankford Station P. O., Philadelphia 20, Pa.
Vacuum-Electronic Engineering Co., 756 Third Ave., Brooklyn 32, N. Y. ADV. PG. 128.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.

VOLTMETERS
VOLTMETERS, ELECTRONIC

See Electrical Testing & Indicating Equipment

WARE—Glass & Quartz

Able Scientific Glass Apparatus Co., 6859 S. Anthony Ave., Chicago 37, Ill. ADV. PG. 128.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Corning Glass Works, Corning, N. Y.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio. ADV. PGS. 75 to 86.
Will Corp., Rochester 3, N. Y.

WARE—Platinum

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark, N. J.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Bishop & Co., J., Malvern, Pa.
Eck & Krebs, Inc., 27–09 40th Ave., Long Island City 1, N. Y.
Will Corp., Rochester 3, N. Y.

WARE—Porcelain

General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J. ADV. PG. 132.
Star Porcelain Co., 61 Muirhead Ave., Trenton 9, N. J.
U. S. Stoneware Co., Akron 9, Ohio
Will Corp., Rochester 3, N. Y.

WASHERS—Laboratory Glassware

Will Corp., Rochester 3, N. Y.

WAXES

Biwax Corp., 3445 Howard St., Skokie, Ill.
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Glyco Products Co., Inc., 26 Court St., Brooklyn 2, N. Y.
Kessler Chemical Co., Inc., State Rd. & Cottman Ave., Philadelphia 35, Pa.
Mitchell Rand Insulation Co., Inc., 51 Murray Street, New York 7, N. Y.
Zophar Mills, Inc., 112–130 26th St., Brooklyn 32, N. Y.

WELL LOGGING EQUIPMENT

Geophysical Measurements Corp., 802 Wright Bldg., Tulsa 3, Okla.
Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Texas Company, Houston, Texas
Well Surveys, Inc., 624 E. 4th St., Tulsa 3, Okla.

WIRE—Slide, Calibrated

Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.

X-RAY DIFFRACTION APPARATUS

Bracke-Seib X-Ray Co., Inc., 293 Third Ave., New York 10, N. Y.
Central Research Laboratories, Inc., Red Wing, Minn.
General Electric Co., X-Ray Dept., 4855 Electric Ave., Milwaukee 14, Wis. ADV. PGS. 75 to 86.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England. ADV. PG. 116.
Picker X-Ray Corp., 300 Fourth Ave., New York 10, N. Y.
St. John X-Ray Laboratory, Califon, N. J.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.

X-RAY EQUIPMENT—Industrial

Bar-Ray Products, Inc., 209 25th St., Brooklyn 32, N. Y. ADV. PGS. 104, 105.
Bracke-Seib X-Ray Co., Inc., 293 Third Ave., New York 10 N. Y.
Cinema-Television Ltd., Worsley Bridge Rd., London S. E. 26, England
General Electric Co., X-Ray Dept., 4855 Electric Ave., Milwaukee 14, Wis. ADV. PGS. 75 to 86.
High Voltage Engineering Corp., 7 University Rd., Cambridge 38, Mass. ADV. PG. 101.
Jarrell-Ash Co., 165 Neuberry St., Boston 16, Mass.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Picker X-Ray Corp., 300 Fourth Ave., New York 10, N. Y.
St. John X-Ray Laboratory, Califon, N. J.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland, Ohio. ADV. PG. Inside Front Cover.

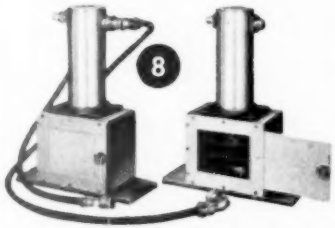
X-RAY TUBES

See Tubes, X-Ray

ELECTRONIC CIRCUITS

6 RCL LINEAR AMPLIFIER, Mark 15 Model 30, is designed especially for proportional, and scintillation counting. Used in conjunction with a standard scaler. Amplifier has a gain set at approximately 100 which is adjustable. The amplifier has a rise time of less than 0.5 microseconds and a decay time of less than 3.5 microseconds. Input sensitivity variable to accept from four millivolts to larger pulses with an input rise time of less than two microseconds and duration of three microseconds or longer. Resolving time is less than five microseconds. Input connector is Amphenol 82-805. Copperplated standard cabinet finished in smoothly finished scuff proof grey hammertone. All hardware is stainless steel. Complete, $275.00. For a spare tube kit of 5 tubes add $10.65.

7 RCL SCINTILLATION HEAD, Mark 10 Model 10, devised particularly for beta gamma counting. Approximately 25 times more sensitive than mica window counter to I^{131} gamma radiations with comparable geometry. Scintillator head consists of plastic enclosed anthracene crystal grown at RCL, a 5819 photomultiplier tube, a cathode follower—all of which are enclosed in a copper, nickel, chrome-plated iron magnetic shield. Head measures 3¾" by 11 inches. Complete with cable connections terminating in Amphenol 83-ISP and AN-3108-14S-2P. $375.00. For a spare tube kit of one tube add $3.00.



8 RCL ALPHA SCINTILLATING COUNTER, Mark 10 Model 15, consists of a cathode follower, a selected 5819 phototube over the sensitive area of which has been sifted zinc-sulfide (cd) phosphor to a thickness of about 10 mg/cm², which is optimum for alpha scintillation work, all enclosed in a copper, nickel, chrome-plated iron magnetic shield. This shield is conveniently attached to a standard RCL mount with six reproducible geometries and a sliding door. The whole is a light tight assembly. Plateau is more than 200 volts long with a slope of from 5-10 percent per 100 volts. Background is approximately zero counts per min. at 1300 v. with 0.25 volt sensitivity. Complete, ready to connect to a standard scaler, no intermediary amplifier required. With cables terminating in Amphenol 82-804 and AN-3108-14S-2P. $365.00. For a spare tube kit of one tube add $3.00.

FOR THE ISOTOPE RESEARCH WORKER . . . RCL

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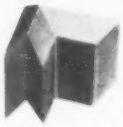

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